APPENDIX 1: W OG WRD GEOTECHNICAL INVESTIGATION REPORT

Reference No: 2172/g

REPORT ON A GEOTECHNICAL INVESTIGATION FOR THE PROPOSED FAR WEST WASTE ROCK DUMP 2 FOR THE THARISA MINE

SEPTEMBER 2021

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REPORT ON A GEOTECHNICAL INVESTIGATION FOR THE PROPOSED FAR WEST WASTE ROCK DUMP 2 FOR THE THARISA MINE NORTH WEST PROVINCE

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REPORT ON A GEOTECHNICAL INVESTIGATION FOR THE PROPOSED FAR WEST WASTE ROCK DUMP 2 FOR THE THARISA MINE NORTH WEST PROVINCE

1. INTRODUCTION

Tharisa Mine is an open-cast chrome mine situated adjacent to the N4 national route, some 25km east of Rustenburg in North West Province, and is owned by the South Africa-based company Tharisa Minerals.

Tharisa Minerals intends to build the Tailings Storage Facility (TSF3) and associated infrastructure, including a Return Water Dam (RWD) and two Waste Rock Dumps. The latter are referred to as West Waste Rock Dump (W WRD2) and Far West Waste Rock Dump (FW WRD2).

This report presents the results of a geotechnical investigation carried out within the FW WRD2 site.

2. TERMS OF REFERENCE

Inroads Consulting was requested by Epoch Resources (Pty) Ltd on behalf of Tharisa Minerals to offer a proposal for undertaking a geotechnical investigation at the site of the FW WRD2.

The investigation was to be undertaken with the following primary objectives:

- to establish the stratigraphy and engineering characteristics of the subsoils underlying the waste rock dump and;
- to determine the shear strength and permeability properties of the underlying soil or rock

The proposal was subsequently prepared by Inroads Consulting cc and submitted to Epoch on 6 July 2021 and was accepted by them.

3. SCOPE OF ACTIVITIES

3.1 Literature Review

Before undertaking the fieldwork, discussed below, a literature survey was carried out in which all information pertaining to the engineering geological and geotechnical conditions was obtained and reviewed. This included the 1:250 000 scale Geological Map[(1)] and Volume 1 of the series Engineering Geology of Southern Africa[(2)].

Details of these publications are presented in the References attached to this Report as Appendix A.

3.2 Fieldwork

The fieldwork was undertaken from 16th to 17th July 2021 and entailed setting out and excavating 19 test pits to depths of between 1,2 to 5,3 m averaging 3,0 m. The pits are located along the northern and western boundary of the existing and presently mined pit. Most of the southern area of the FW WRD is occupied by dump rock and no pits were excavated in this area. Limited profiling of an about 5 to 7 m deep face of an excavation of the mine pit, located in the vicinity of TP18 and TP19, was also undertaken at points referenced PT1 to PT3.

The test pits, of which the positions were determined and set out by Epoch, were put down employing a Komatsu PC300 excavator and their final positions were coordinated using a hand-held Garmin GPS. The sidewall of the exposed soil was also photographed.

The pits and the excavation face were profiled following standard methods and procedures prescribed in the document *Guidelines for Soil and Rock Logging in South Africa (2002)*[3] and their positions are presented in the site plan attached as Appendix B.

Samples were recovered from certain of the soil horizons and sent to Specialised Testing Laboratory and SGS Matrolab, both ISO accredited civil engineering testing laboratories in Pretoria, South Africa.

4. SITE DESCRIPTION

The area of the FW WRD is largely occupied by the presently mined open pit and dump rock located along its southern boundary. Due to this, the test pits were only located along the northern and western boundary of the pit, which is accessible by the mine road running alongside it. The overburden or topsoil is stockpiled along the boundary.

Photographs of the site are presented in Appendix C of this report.

5. GEOLOGY

According to the 1:250 000 geological series map referenced 2526 Rustenburg, the area is largely underlain by leuconorite, anorthosite, pyroxenite and chromitite of the Matlhagame Norite Anorthosite of the Schilpadnest Sub-suite, Rustenburg Layered Suite, Bushveld Complex. Some parts of the site to the north are shown to be underlain by anorthosite.

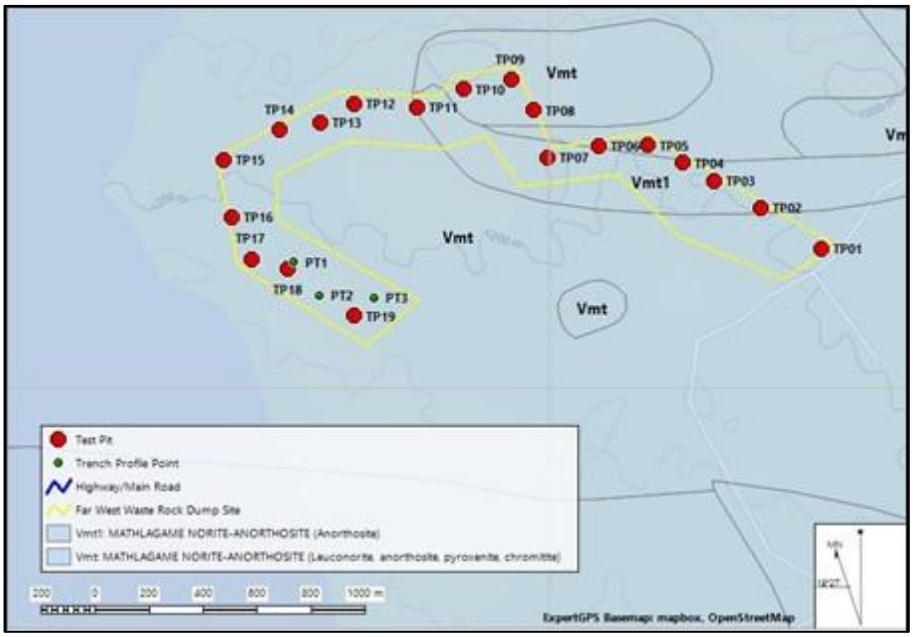

Figure 1: Surface geology in the region (from 1:250 000 Geological series).

6. GROUND CONDITIONS

6.1 Subsoils

The subsoil conditions within the site are described below and are summarised in Table 1 overleaf and in Appendix D attached to this report. The test pits with similar soil profiles are grouped into Zones A and B.

Zone A

The subsoil conditions in Zone A, as represented by test pits TP01 to TP12, are characterised by a black, soft to firm, sandy clay, or black turf. This overlies medium dense to very dense silty sand of residual norite origin at depths averaging 1,4 m. The residual sand often grades to very soft rock within which the excavator refused at depths ranging from 1,6 to 3,7 m. In test pit TP12, however, the sand extends to a depth of 5,3 m with no refusal occurring. In test pit TP09, fill, comprising loose, silty sand with gravel and cobbles was encountered to a depth of 5,0 m. This is probably an excavation that has been backfilled.

Zone B

The subsoil conditions in Zone B are represented by test pits TP13 to TP19 and the three points, PT1 to PT3, profiled on the excavation face of the mine pit and in the vicinity of TP18 and TP19. The subsoils are characterised by a very stiff, or very dense, clayey sand horizon of alluvial origin. It becomes more clayey with depth and in test pits TP15 and T16 is underlain by a residual clayey sandy silt horizon of unknown origin at depths of between 2,5 to 3,0 m.

On the excavation face, represented by points PT1 and PT2, the alluvium extends to depths of between 4,5 to 5,5 m and is separated from the underlying sandy residual norite, or very soft rock, by a thin pebble marker horizon.

In test pit TP14 the alluvium extends to the bottom of the hole at 4,5 m, however, in test pits TP13, TP17, TP18 and TP19, it is very stiff and the excavator refused on it or on the pebble marker and nodular ferricrete located beneath it at depths of between 1,2 to 2,1 m, averaging 1,5 m below the present ground surface.

To the south of the site, the alluvium is cemented with nodular and hardpan ferricrete occurring at about 1,7 m. The excavator refused on the ferricrete horizon in test pit TP19 at about 2,1 m. On the excavation face at point PT3, the nodular ferricrete extends to the bottom of the excavation at 5,0 m.

The detailed soil profiles of the test pits and excavation face are attached to this report as Appendix D, and a summary of the test pit profiles are also attached with these. Photographs of the pits are presented in Appendix E.

6.2 Groundwater

No groundwater was encountered in any of the pits.

Table 6.1: Summary of profiles

Zone	Test Pit no.	Soil Description									Refusal
		Fill - Silty sand/ Clay sand + gravels & cobbles	Hillw ash - Silty sand	Black Turf / Clay	Alluvium / Clayey/ silty sand	Pebble marker - Gravel	Nodular ferricrete - Gravel	Residual - Clayey sandy silt/Sandy silty clay	Residual - Silty sand	Norite/ Chromitite - Very soft rock	
		SM-SC		*MH/CH*					*WS-SC, SM*		
A	TP01			0.0-0.8					0.8-3.7		Refusal on very soft rock norite
	TP02			0.0-1.4						1.4-1.6	Refusal on very soft rock norite
	TP03			0.0-1.3					1.3-3.3		Refusal on very soft rock norite
	TP04			0.0-1.4					1.4-2.6		Refusal on very soft rock norite
	TP05	0.0-0.4		0.4-1.9					1.9-3.4		Refusal on very soft rock norite
	TP06			0.0-0.8					0.8-1.6	1.6-1.8	Refusal on very soft rock norite
	TP07	0.0-0.1		0.1-1.5					1.5-1.8	1.8-1.9	Refusal on very soft rock norite
	TP08	0.0-0.2		0.2-1.4					1.4-1.6	1.6-1.7	Refusal on very soft rock norite
	TP09	0.0-5.0									
	TP10			0.0-0.7						0.7-2.8	Refusal on very soft rock chromitite
	TP11			0.0-0.7					0.7-2.5		Refusal on very soft rock norite
	TP12			0.0-2.7					2.7-5.3		
		SM-SC	*SP-SM*		*SC*	*GC*	*GC*	*CL, MH*	*SW-SC, SM*		
B	TP13				0.0-1.3						Refusal on very stiff/very dense clayey sand.
	TP14				0.0-4.5						
	TP15				0.0-2.4	2.4-2.5		2.5-4.8			
	TP16	0.0-0.2			0.2-3.0			3.0-5.3			
	TP17				0.0-1.2	1.2-1.5					Refusal on very dense cobbles and gravels.
	TP18				0.0-1.2						Refusal on very stiff/very dense clayey sand.
	TP19	0.0-0.9			0.9-1.7		1.7-2.1				Refusal on very stiff/very dense clayey sand and nodular ferricrete.
	PT1				0.0-4.5			4.5-6.0			Gravels and highly weathered rock encountered at the bottom of the excavation
	PT2	0.0-1.0			1.0-5.5				5.5-7.0		
	PT3		0.0-0.9		0.9-1.7		1.7-5.0				

7. LABORATORY TESTING

Disturbed and undisturbed samples were recovered from the underlying soil horizons and a range of tests were carried out on them to assess their engineering characteristics. The tests were undertaken to TMH, SANS and ASTM specifications and the results are presented in Appendix F and discussed in more detail below.

7.1 Indicator Tests

To more accurately identify and classify the soil horizons encountered, particle size distribution analysis and Atterberg limit determinations were carried out on the samples of black turf, alluvium and the residual horizons which cover the site.

With the exception of the sandy residual norite, it is evident from the test results that the black turf, alluvium and residual norite silt, encountered in test pit TP15, are of medium to high expansive potential, according to the method of Van der Merwe[4], having weighted plasticity index of between 13 and 25. Their grading moduli are all less than 1,0 which is indicative of their fine-grained texture.

The sandy residual norite has a weighted plasticity index of 8 and is also denoted as “NP”, which suggests that it is of low expansive potential and non-plastic, respectively. Its grading modulus of between 1,44 to 2,09 indicates that it is medium to coarse grained. It also classifies as “SW-SC” and “SM” soil types according to the Unified Soil Classification System (USCS)[5], which is well-graded sand to clayey sand and silty sand respectively. It also classifies as an A-2-4 to A-1-b soil type according to the AASHTO classification system[6], these being silty sands with gravel and have a “good” rating for use as subgrade.

The AASHTO classification system groups the black turf, alluvium and the silty residual encountered in test pit TP15 as A-7-5 to A-7-6 soil types, which are generally clayey soil having a “poor” rating for use as subgrade. Except for the alluvium, these soils classify as MH and occasionally a CL soil type according to the USCS, which is silt of high plasticity and clay of low plasticity respectively. The alluvium classifies as SC and SM soil types which are clayey sand and silty sand respectively.

Table 7.1: Summary of indicator tests

Test pit	Depth (m)	Soil Description	LL	PI	PI $_{ws}$	LS	GM	MIT Size Fraction - %				Classification	
								Gravel	Sand	Silt	Clay	AASHTO	USCS
TP01	2.1 – 2.4	Residual norite - Slightly silty sand	-	NP	-	0	1.44	11	82	7	1	A-2-4	SW-SC
TP05	1.0 – 1.3	Black turf – Sandy clay	69	28	25	13	0.38	4	26	28	42	A-7-5	MH
TP05	1.9 – 3.4	Residual norite - Silty sand & gravel	29	8	2	4.5	2.09	47	45	6	2	A-2-4	SW-SC
TP12	2.7 – 5.0	Residual norite - Silty sand	-	NP	-	0	1.52	16	73	10	1	A-1-b	SM
TP13	0.4 – 1.3	Alluvium - Clayey sand	34	18	13	9.5	0.97	0	73	9	18	A-2-6	SC
TP14	3.1 – 3.4	Alluvium - Clayey sand	44	14	10	7	0.82	2	58	12	27	A-7-5	SM
TP15	2.5 – 3.0	Residual - sandy clay	49	23	19	11.5	0.56	4	35	17	44	A-7-6	CL
TP15	3.2 – 3.5	Residual - clayey sandy silt	56	20	18	9	0.33	1	28	32	39	A-7-5	MH

LL = liquid limit; PI = plasticity index; LS = linear shrinkage; GM = grading modulus, USCS = Unified Soil Classification System, AASHTO = American Association of State Highway and Transportation Officials

Table 7.2: Summary of consolidated undrained triaxial tests

Sample Type	Test pit no.	Depth (m)	Soil Description	Dry density (kg/m^3)	Moisture Content (%)	Cohesion c' (kPa)	Angle of friction φ' (degrees)
Remoulded	TP01	2.1 – 2.4	Residual norite - Slightly silty sand	1801	8	5	31
Undisturbed	TP05	1.0 – 1.3	Black turf – sandy clay	1280	34	7	16
	TP14	3.1 – 3.4	Alluvium - Clayey sand	1857	13.6	10	20
	TP15	3.2 – 3.5	Residual - clayey sandy silt	1446	26	1	28

Table 7.3: Coefficient of permeability

Sample Type	Test pit no.	Depth (m)	Soil Type	Moisture Content (%)	Dry Density ρ_d (kg/m^3)	Coefficient of Permeability k (m/sec)
Remoulded	TP01	2.1 – 2.4	Residual norite - Slightly silty sand	6.8	1773	6.92×10^{-7}
Undisturbed	TP05	1.0 – 1.3	Black turf – Sandy clay	34.5	1225	3.09×10^{-10}
	TP14	3.1 – 3.4	Alluvium - Clayey sand	14.8	1841	8.71×10^{-10}
	TP15	3.2 – 3.5	Residual - clayey sandy silt	31.1	1231	2.25×10^{-8}

7.2 Shear Strength Tests

Consolidated undrained triaxial tests were carried out on undisturbed samples of the black turf, alluvium and the clayey sandy silt residual horizon encountered in test pit TP15. Due to the friable nature of the sandy residual norite sample taken from test pit TP01, triaxial specimens could not be cut and as a result, the specimens were prepared by remoulding the soil to a dry density and moisture content determined using the lump density method.

The results of the remoulded and undisturbed samples are summarised in Table 7.2 above.

The black turf and alluvium have an effective friction angle of 16 and 20 degrees and effective cohesion of 7 kPa and 10 kPa, respectively, and this agrees with the A-7-5 and MH to SC material they have been classified as belonging to.

The residual soils have an effective friction angle of 28 to 31 degrees and effective cohesion of 1 to 7 kPa. This also agrees with the typical shear strength of the material tested, which are the MH to SW-SC soil types. The cohesion of 1 kPa for the clayey sandy silt sample taken from TP15, however, is surprisingly low for the MH soil type tested.

7.3 Permeability Tests

The permeability of the remoulded and undisturbed samples of the selected soil horizons was determined in the flexible wall triaxial cell and their results are summarised in Table 7.3 above.

The permeability coefficients of the sandy residual norite, silty residual norite and black turf at 10^{-7} m/sec, 10^{-8} m/sec and 10^{-10} m/sec is typical for the SW-SC and MH soil types respectively.

The alluvium has a permeability coefficient of 10^{-10} m/sec and seems to be low for the material classified as an SM soil type.

8. SUMMARY AND RECOMMENDATIONS

8.1 Soil Profile

The subsoil conditions within the site as described in detail in section 6.1 are divided into two zones, namely Zone A and B.

Zone A comprises a 1,4 m thick black turf layer as soft to firm, sandy clay which overlies medium dense to very dense silty sand of residual norite origin. The latter often grades to very soft rock within which the excavator refused at depths ranging from 1,6 to 3,7 m. No refusal occurred in test pit TP12 at a depth of 5,3 m.

Zone B is characterised by a very stiff, or very dense, clayey sand horizon of alluvial origin underlain by a residual clayey sandy silt horizon of unknown origin. On the excavation face, the alluvium extends to depths of between 4,5 to 5,5 and to the south of the site is cemented with nodular and hardpan ferricrete occurring below about 1,7 m. The excavator refused on the ferricrete horizon in test pit TP19 at about 2,1 m, however, on the excavation face at point PT3, the nodular ferricrete extends to the bottom of the excavation at 5,0 m.

In places, the black turf and alluvium are overlain by fill or topsoil and/or hillwash horizons comprising mainly silty sand with abundant roots and gravels. These horizons are of variable thickness ranging from 0,1 to 1,0 m, and it is suggested that they be incorporated into those of the black turf or alluvium underlying them when carrying out a stability analysis. The pebble marker encountered beneath the alluvium is also very thin and irregular and can be ignored when in any stability analysis.

8.2 Design Parameters

Given the above, for design purposes, the following shear strength parameters and coefficients of permeability are considered appropriate for the in-situ soil types encountered within the site.

The nodular ferricrete occurring sporadically to the south of the site is granular and no samples could be taken to determine its shear strength parameters and permeability, however, typical values have been estimated and they are presented in Table 8.1 below.

Table 8.1: Soil engineering parameters for design

Soil Horizon	Soil description	USCS	φ' (degrees)	c' (kN/m^2)	ρ_d (kg/m^3)	k (m/sec)
Black turf	Sandy clay	MH	16	7	1300	10^{-10}
Alluvium	Clayey sand	SC	20	10	1800	10^{-10}
Nodular ferricrete	Silty/clayey gravel	GC*	35*	0*	1900*	10^{-8} *
Residual norite	Clayey sandy silt	MH	28	1	1400	10^{-8}
	Silty sand	SW-SC & SM	31	5	1800	10^{-7}

USCS = Unified Soil Classification System; φ' = effective friction angle; c' = effective cohesion; ρ_d = dry density; * = estimated; k = coefficient of permeability.

8.3 Stability of Waste Rock Dump

For design purposes, Table 8.1 above presents an estimate of the engineering parameters of the soils discussed in this report and the attached summary of the profiles.

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for Inroads Consulting cc

Brian Harrison Pr Eng
for Inroads Consulting cc

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CIVIL ENGINEERS

APPENDIX A

References

Ref	Title	Author	Publisher	Year
1	1:250 000 Geological Series, 2526 Rustenburg	The Chief Director Geological Survey	The Government Printer, Pretoria, South Africa	
2	Engineering Geology of Southern Africa. Volume 1.	Brink A. B. A.	Building Publications, South Africa.	1979
3	Guidelines for Soil and Rock Logging in South Africa.	Brink A. B. A. Bruin R. M. H.	Association of Engineering Geologists South Africa Section. South African Institution of Civil Engineers. South African Institute of Engineering Geologists.	2002
4	The Prediction of Heave from the Plasticity Index and Percentage Clay Fraction.	Van der Merwe D.H.	Trans. S.A. Ins. Civ. Eng. No. 6,	1964
5	Unified Soil Classification System for Engineering Purposes.	ASTM	ASTM Designation D-2487	1967
6	AASHTO – Classification of Soils and Soil-Aggregate Mixtures	AASHTO	AASHTO Designation M-145	1970

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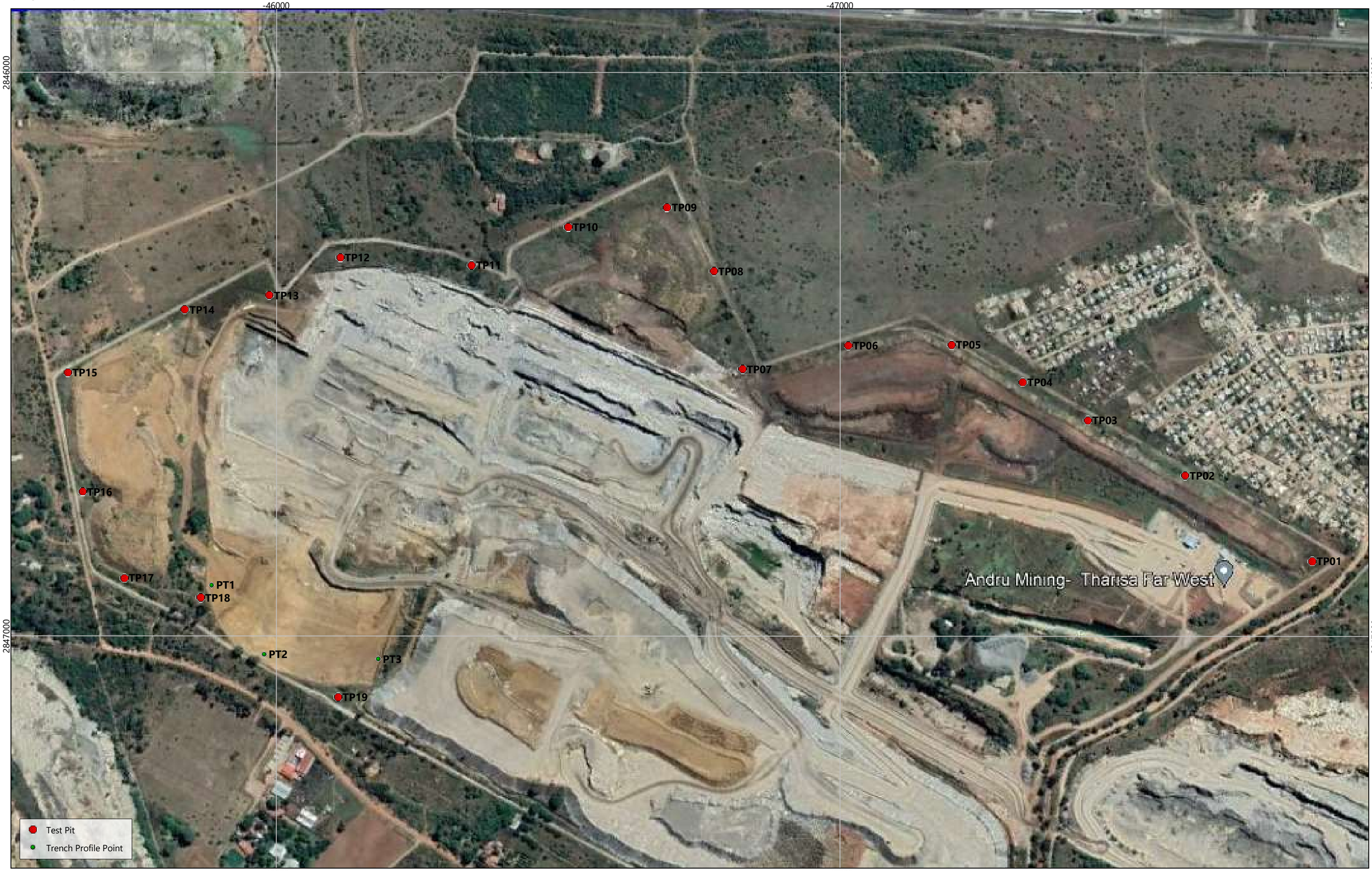
APPENDIX B

Site Plan



SITE PLAN SHOWING POSITIONS OF TEST PITS

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100 0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 m

Scale: 1 : 6000. Hartebeesthoek94 Lo27 (meters) coordinate grid at 1 km spacing.

MN GN
18°28' 79°48'

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APPENDIX C

Photographic Record

PHOTOGRAPHIC RECORD	
SITE NAME: Tharisa FW WRD2	
PHOTOGRAPH **1**	
Comments: View of overburden/topsoil stockpile from near TP01 looking west	
PHOTOGRAPH **2**	
Comments: View of overburden/topsoil stockpile in the vicinity of TP09 looking east	

PHOTOGRAPHIC RECORD	
SITE NAME: Tharisa FW WRD2	
PHOTOGRAPH **3**	
Comments: View of mine pit from near PT2 looking north-west	
PHOTOGRAPH **4**	
Comments: View of excavation face near PT3 with waste rock dump in the background looking south-east	

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APPENDIX D

Soil Profiles

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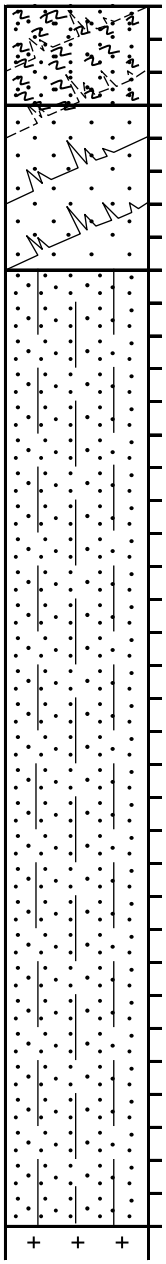
PROFILE SHEET

TP01

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846866
Y -047837



0.0 – 0.3: Moist, dark brown, medium dense, shattered, CLAYEY SILTY SAND with abundant roots. *Topsoil/Hillwash?*

0.3 – 0.8: Moist to very moist, dark brown, firm, shattered, SANDY SILTY CLAY. *Hillwash/Black turf.*

0.8 – 3.7: Slightly moist, cream white speckled black stained orange brown, medium dense, slightly SILTY SAND. *Residual norite.*

2.1 – 2.4: Contains abundant pockets of sandy clay to 2,0 m.

Loose to medium dense in places.

NOTES:
1. Bottom of hole at 3,7 m. Refusal on very soft rock norite
2. No groundwater seepage encountered.
3. Undisturbed sample taken from 2,1 to 2,4 m.
4. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 16-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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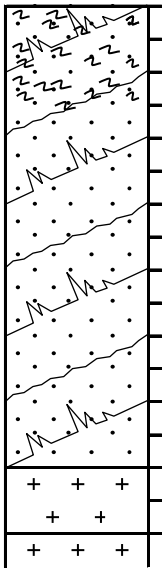
PROFILE SHEET

TP02

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846715
Y -047612



Moist to very moist, dark brown grey, firm, shattered, slickensided, SANDY CLAY. *Black turf.*

Contains abundant sand and roots to 0,3 m.

Highly weathered, cream white speckled black stained light brown, coarse grained, highly to moderately fractured, very soft rock. NORITE.

NOTES:
1. Bottom of hole at 1,6 m. Refusal on very soft rock norite
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 16-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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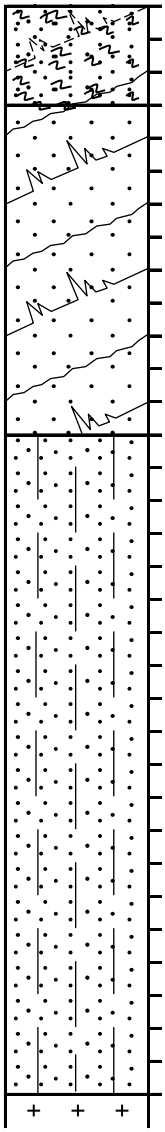
PROFILE SHEET

TP03

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846617
Y -047439



0.0 – 0.3: Moist, dark brown, medium dense to dense, shattered, CLAYEY SILTY SAND with abundant roots. *Topsoil/Hillwash?*

0.3 – 1.3: Moist to very moist, dark brown grey, firm, shattered, slickensided, SANDY CLAY. *Black turf.*

Contains abundant sand at base.

1.3 – 3.3: Slightly moist, cream white speckled black stained light brown, dense to very dense becoming very dense to very soft rock, slightly SILTY coarse SAND. *Completely weathered norite.*

Contains abundant pockets of weathered gravels and very soft rock.

Below 1,8 m appears as very dense to very soft rock.

NOTES:
1. Bottom of hole at 3,3 m. Refusal on very soft rock norite
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 16-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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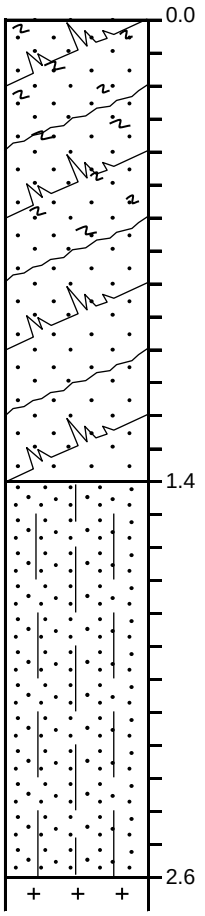
PROFILE SHEET

TP04

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846549
Y -047323



Very moist, dark grey/black, soft, shattered, slickensided, SANDY CLAY with abundant roots to 0,7 m. *Black turf/Residual.*

Slightly moist, cream white speckled grey, loose to medium dense becoming dense below 2,4 m, slightly SILTY coarse SAND. *Residual norite.*

Contains abundant pockets of clay to 2,0 m.

NOTES:
1. Bottom of hole at 2,6 m. Refusal on very soft rock norite
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 16-Jul-21

Water seepage | Undisturbed sample | Bulk sample
Standing water | Disturbed sample | *In-situ* test

Ref: 2172/g

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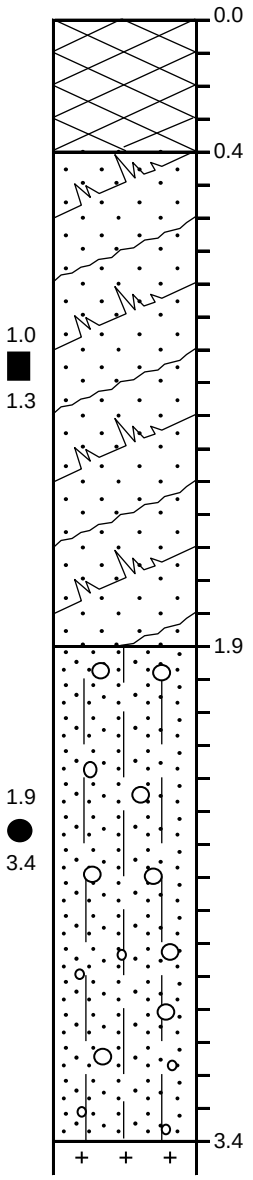
PROFILE SHEET

TP05

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846483
Y -047197



0.0 – 0.4: Very moist, brown mottled grey, soft, CLAYEY SAND with scattered gravels and cobbles. *Fill.*

0.4 – 1.9: Very moist, dark grey/black, very soft to soft, shattered, slickensided, SANDY CLAY. *Black turf/Residual.*

Contains abundant gravels below 1,8 m.

1.9 – 3.4: Very moist, light olive speckled cream white and black, dense, relict jointed, SILTY SAND with abundant gravels. *Residual norite.*

Becomes very dense with depth.

Between 1,9 to 2,2 m contains abundant cobbles and very soft rock.

NOTES:
1. Bottom of hole at 3,4 m. Refusal on very soft rock norite
2. No groundwater seepage encountered.
3. Undisturbed sample taken from 1,0 to 1,3 m.
4. Disturbed sample taken from 1,9 to 3,4 m.
5. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 16-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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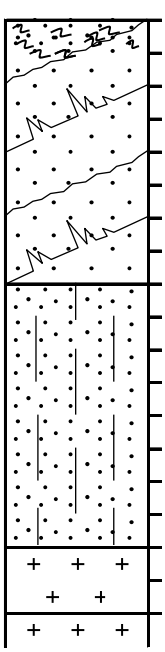
PROFILE SHEET

TP06

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846484
Y -047014



Very moist, dark grey/black, soft to firm, shattered, slickensided, SANDY CLAY. *Black turf/Residual.*

Contains abundant sand and roots to 0,1 m.

Very moist, cream white speckled black and stained brown, medium dense, SILTY SAND with abundant very dense and friable pockets, slightly SILTY SAND. *Residual norite.*

Contains abundant clay pockets to 1,1 m.

Highly weathered, cream white speckled black and stained brown, coarse grained, highly to moderately fractured, very soft rock. NORITE.

NOTES:
1. Bottom of hole at 1,8 m. Refusal on very soft rock norite
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 16-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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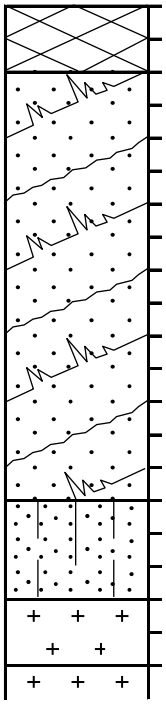
PROFILE SHEET

TP07

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846526
Y -046826



0.0 – 0.1: Slightly moist, brown and olive, loose to medium dense, SILTY SAND with abundant gravels and many roots. *Fill.*

0.1 – 1.5: Very moist, dark grey/black, soft to firm, shattered, slickensided, SANDY CLAY. *Black turf/Residual.*

1.5 – 1.8: Very moist, cream white speckled black and stained brown, medium dense to dense, SILTY SAND with abundant dense and friable pockets, slightly SILTY SAND. *Residual norite.*

1.8 – 1.9: Highly weathered, cream white speckled black and stained brown, coarse grained, highly to moderately fractured, very soft rock. NORITE.

NOTES:
1. Bottom of hole at 1,9 m. Refusal on very soft rock norite
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 16-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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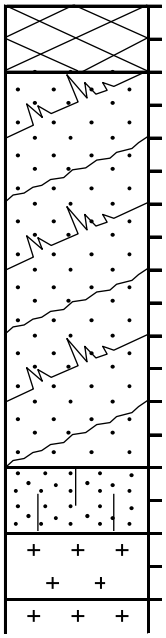
PROFILE SHEET

TP08

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846352
Y -046775



0.0 – 0.2: Very moist, grey and olive, firm, SANDY CLAY & SILTY SAND with gravel. *Fill.*

0.2 – 1.4: Very moist, dark grey/black speckled white, soft, shattered, slickensided, SANDY CLAY. *Black turf/Residual.*

1.4 – 1.6: Very moist, cream white speckled black and stained grey brown, medium dense to dense, SILTY SAND with abundant friable gravels, SILTY SAND. *Residual norite.*

1.6 – 1.7: Highly weathered, cream white speckled black and stained brown, coarse grained, highly to moderately fractured, very soft rock. NORITE.

NOTES:
1. Bottom of hole at 1,7 m. Refusal on very soft rock norite
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 16-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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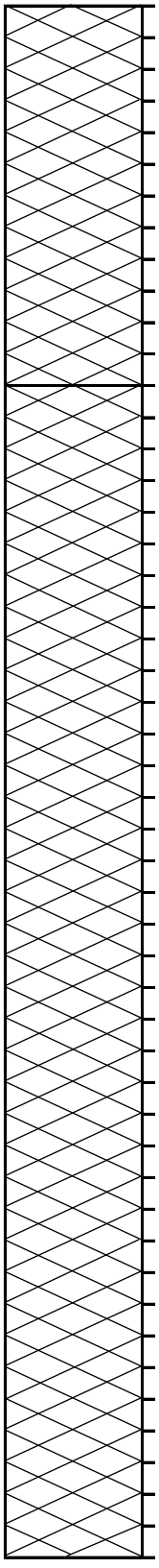
PROFILE SHEET

TP09

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846239
Y -046692



Very moist, dark grey and dark brown speckled white and mottled reddish brown, firm, SANDY CLAY with abundant sand pockets and scattered cobbles. *Fill.*

Slightly moist, light yellow olive and banded grey, loose, SILTY coarse SAND with scattered fine to coarse gravels and cobbles. *Fill.*

Contains occasional ash bands in places.

NOTES:
1. Bottom of hole at 5,0 m. Not to refusal.
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 16-Jul-21

▽ Water seepage
▼ Standing water
■ Undisturbed sample
● Disturbed sample
I Bulk sample
⊢⊣ *In-situ* test

Ref: 2172/g

Sheet 1 of 1

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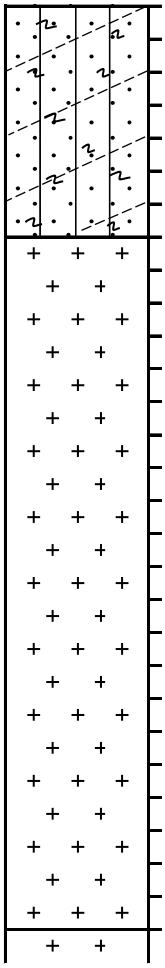
PROFILE SHEET

TP10

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846274
Y -046517



Very moist, dark brown, <u>firm to stiff</u>, intact, SANDY CLAYEY SILT with scattered roots. *Hillwash.*

Highly weathered, dark grey stained orange and light yellow, coarse grained, highly fractured, <u>very soft to medium hard rock</u>. *Chromitite?*

Contains abundant pockets of dense sand to 1,1 m.

NOTES:
1. Bottom of hole at 2,8 m. Refusal on <u>very soft rock</u> chromitite
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 16-Jul-21

▽ Water seepage
▼ Standing water
■ Undisturbed sample
● Disturbed sample
I Bulk sample
⊢⊣ *In-situ* test

Ref: 2172/g

Sheet 1 of 1

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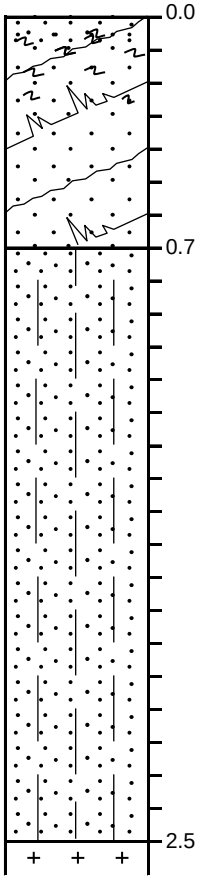
PROFILE SHEET

TP11

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846342
Y -046345



Very moist, dark grey/black speckled white, soft, shattered, slickensided, SANDY CLAY. *Black turf/Residual.*

Contains abundant sand and roots to 0,3 m.

Slightly moist, cream white speckled black and stained brown, dense becoming very dense with depth, relict jointed, SILTY SAND with abundant very dense and friable pockets, slightly SILTY SAND. *Residual norite.*

NOTES:
1. Bottom of hole at 2,5 m. Refusal on very soft rock norite
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 16-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

Sheet 1 of 1

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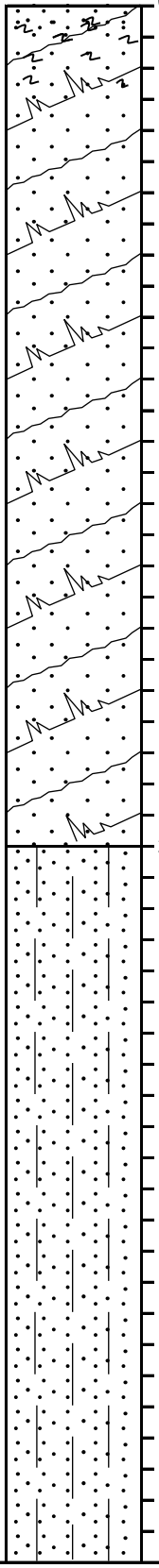
PROFILE SHEET

TP12

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846328
Y -046112



Very moist, dark grey/black, firm to stiff, shattered, slickensided, SANDY CLAY. *Black turf/Residual.*

Contains abundant sand and roots to 0,3 m.

Slightly moist, cream white speckled black and stained brown, loose to medium dense becoming medium dense below 4,3 m, relict jointed, SILTY SAND . *Residual norite.*

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 17-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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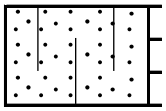
PROFILE SHEET

TP12 cont

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846328
Y -046112



Slightly moist, cream white speckled black and stained brown, medium dense, relict jointed, SILTY SAND . *Residual norite.*

NOTES:
1. Bottom of hole at 5,3 m. Not to refusal.
2. No groundwater seepage encountered.
3. Disturbed sample taken from 2,7 to 5,0 m.
4. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 17-Jul-21

▽ Water seepage
▼ Standing water
■ Undisturbed sample
● Disturbed sample
I Bulk sample
⊢⊣ *In-situ* test

Ref: 2172/g

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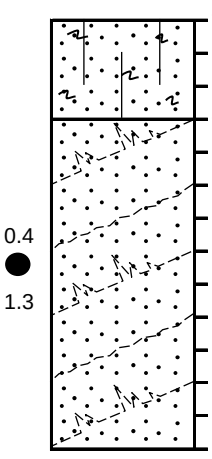
PROFILE SHEET

TP13

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846395
Y -045987



0.0 – 0.35: Slightly moist, dark brown, medium dense, clayey SILTY SAND with scattered roots.. *Hillwash/Aeolian?*

0.4 – 1.3: Slightly moist, dark brown speckled white, stiff to very stiff, shattered, slickensided, CLAYEY SAND with scattered nodular calcrete. *Transported.*

NOTES:
1. Bottom of hole at 1,3 m. Refusal on very stiff/very dense clayey sand.
2. No groundwater seepage encountered.
3. Disturbed sample taken from 0,4 to 1,3 m.
4. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 17-Jul-21

▽ Water seepage ▼ Standing water ■ Undisturbed sample ● Disturbed sample ⌶ Bulk sample ⊢⊣ *In-situ* test

Ref: 2172/g

Sheet 1 of 1

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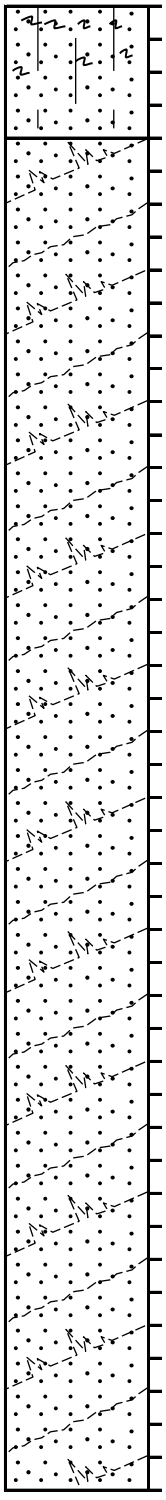
PROFILE SHEET

TP14

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846421
Y -045837



0.0 – 0.4: Slightly moist, light brown, loose, SILTY SAND with many roots. *Hillwash/Aeolian?*

Contains abundant roots to 0,1 m.

0.4 – 4.5: Slightly moist becoming moist with depth, brown becoming mottled orange brown and light grey below 0,6 m, stiff to very stiff, shattered, slickensided, CLAYEY SAND with scattered ferruginous nodules. *Alluvium?*

Becomes firm to stiff below 2,0 m.

NOTES:
1. Bottom of hole at 4,5 m. Not to refusal.
2. No groundwater seepage encountered.
3. Undisturbed sample taken from 3,1 to 3,4 m.
4. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 17-Jul-21

▽ Water seepage
▼ Standing water
■ Undisturbed sample
● Disturbed sample
I Bulk sample
⊢⊣ *In-situ* test

Ref: 2172/g

Sheet 1 of 1

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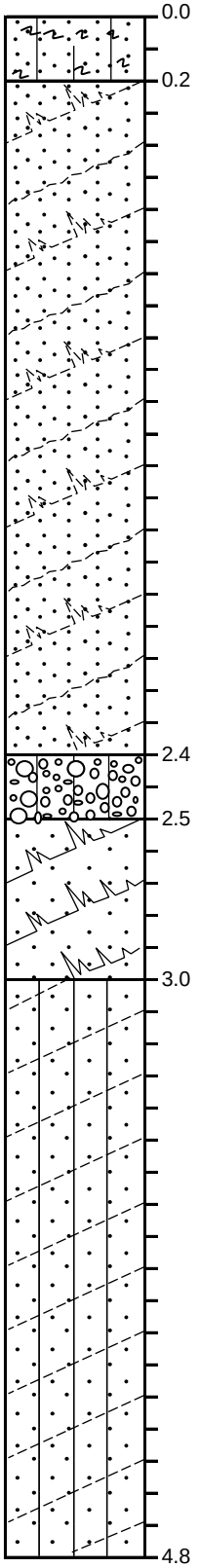
PROFILE SHEET

TP15

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846532
Y -045629



0.0 – 0.2: Slightly moist, light brown, loose, SILTY SAND with abundant roots. *Hillwash/Topsoil.*

0.2 – 2.4: Slightly moist, dark grey brown becoming mottled orange below 0,6 m, stiff, shattered, CLAYEY SAND. *Alluvium?*

2.4 – 2.5: Matrix supported, sub-rounded and rounded, fine medium and abundant coarse quartz GRAVELS in a matrix as above. *Pebble marker.*

Overall consistency is dense.

2.5 – 3.0: Very moist, dark grey brown, firm to stiff, shattered, SANDY CLAY. *Residual?*

3.0 – 4.8: Very moist, light yellow brown mottled white and grey, soft to firm, CLAYEY SANDY SILT. *Residual?*

NOTES:
1. Bottom of hole at 4,8 m. Not to refusal.
2. No groundwater seepage encountered.
3. Disturbed sample taken from 2,5 to 3,0 m.
4. Undisturbed sample taken from 3,2 to 3,5 m.
5. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 17-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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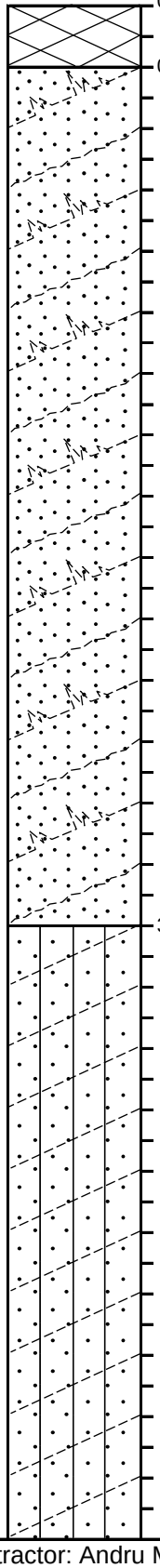
PROFILE SHEET

TP16

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846744
Y -045656



0.0 – 0.2: Clast supported, sub-angular and angular, fine medium and abundantly coarse quartz GRAVELS in a matrix of dry, brown silty sand. *Fill.*

Overall consistency is medium dense.

0.2 – 3.0: Moist becoming very moist with depth, dark brown mottled dark grey, stiff to very stiff, shattered, slickensided, CLAYEY SAND. *Alluvium?*

Contains scattered rounded cobbles at about 1,0 m.

Becomes firm to stiff below 2,0 m.

3.0 – : Very moist, light orange brown mottled cream white and brown, firm, pinholed, CLAYEY SANDY SILT. *Residual?*

Becomes light yellow brown with depth.

Becomes more sandy with depth.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 17-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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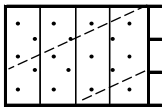
PROFILE SHEET	TP16 cont
Epoch Resources (Pty) Ltd	X 2846744
Tharisa Far West Waste Rock Dump	Y -045656



Very moist, light orange brown mottled cream white and brown, firm, pinholed, CLAYEY SANDY SILT. *Residual?*

NOTES:
1. Bottom of hole at 5,3 m. Not to refusal.
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 17-Jul-21

Water seepage ▽ | Standing water ▼ | Undisturbed sample ■ | Disturbed sample ● | Bulk sample ⌶ | *In-situ* test ⊢⊣

Ref: 2172/g

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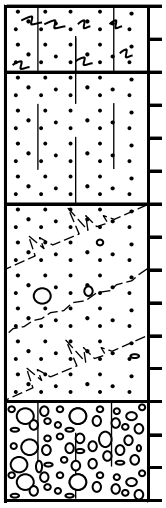
PROFILE SHEET

TP17

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846897
Y -045730



Dry, dark grey brown, loose to medium dense, SILTY SAND with many roots. *Topsoil.*

Slightly moist, dark brown, dense, pinholed and shattered, slightly clayey SILTY SAND. *Hillwash/Aeolian?*

Slightly moist, dark brown mottled dark orange, stiff to very stiff, CLAYEY SAND with abundant gravels. *Alluvium?*

Clast and matrix supported, rounded, fine medium and coarse GRAVELS in a matrix as above. *Pebble marker.*

Overall consistency is very dense.

NOTES:
1. Bottom of hole at 1,5 m. Refusal on very dense tightly packed cobbles and gravels.
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 17-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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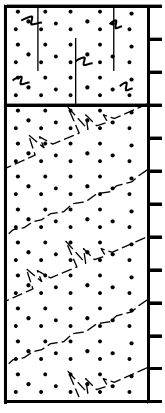
PROFILE SHEET

TP18

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846932
Y -045865



Dry, dark brown, medium dense to dense, pinholed, slightly clayey SILTY SAND with abundant coarse roots. *Hillwash/Aeolian?*

Slightly moist, dark brown mottled dark orange, stiff to very stiff, CLAYEY SAND. *Alluvium?*

NOTES:
1. Bottom of hole at 1,2 m. Refusal on very stiff/very dense clayey sand.
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 17-Jul-21

Water seepage | Undisturbed sample | Bulk sample
Standing water | Disturbed sample | *In-situ* test

Ref: 2172/g

INROADS CONSULTING
CIVIL ENGINEERS

PO Box 87318
Houghton
2041

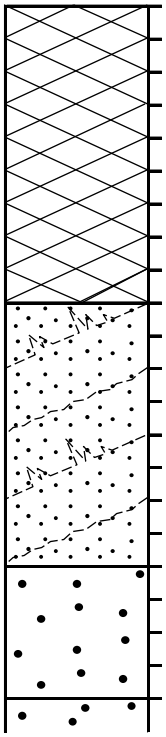
Tel: (011) 443 7811
Fax: (011) 443 2951
e-mail: admin@inroads-sa.co.za

PROFILE SHEET

TP19

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2847108
Y -046109



0.0 – 0.9: Slightly moist, light brown mottled orange brown, loose, SILTY coarse SAND with abundant fine gravel and roots. *Fill?*

0.9 – 1.7: Slightly moist, dark grey brown stained light brown, stiff to very stiff, shattered, CLAYEY SAND. *Alluvium?*

Contains abundant light brown sand.

1.7 – 2.1: Clast to matrix supported, sub-angular and sub-rounded, fine and medium ferruginous nodules in a matrix as above. *Nodular ferricrete.*

Overall consistency is dense to very dense.

NOTES:
1. Bottom of hole at 2,1 m. Refusal on very stiff/very dense clayey sand and abundant ferruginous nodules.
2. No groundwater seepage encountered.
3. Co-ordinates determined from Garmin hand-held GPS to WGS 84 system.

Contractor: Andru Mining
Machine: Komatsu PC300

Profiled by: MC Shuping
Date profiled: 17-Jul-21

▽ Water seepage
▼ Standing water
■ Undisturbed sample
● Disturbed sample
I Bulk sample
⊢⊣ *In-situ* test

Ref: 2172/g

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2041

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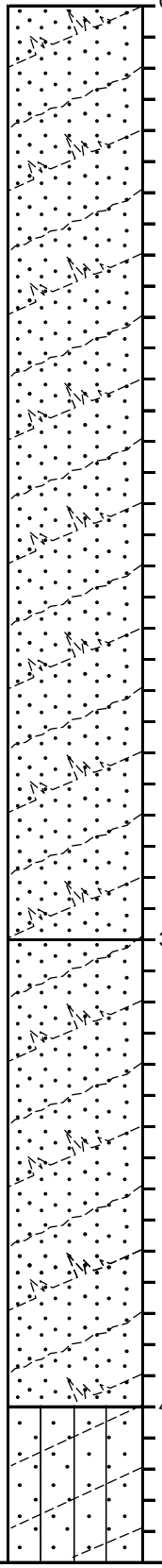
PROFILE SHEET

PT1

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846909
Y -045885



0.0 – 3.0: Dry, brown, shattered, CLAYEY SAND. *Alluvium.*

3.0 – 4.5: Dry, brown, shattered, CLAYEY SAND/SANDY CLAY. *Alluvium.*

4.5 – : Dry, brown and orange brown, CLAYEY SANDY SILT. *Residual.*

Contractor: -
Machine: -

Profiled by: MC Shuping
Date profiled: 17-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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Houghton
2041

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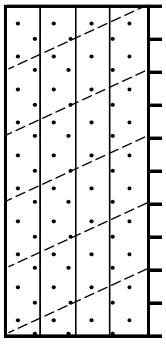
PROFILE SHEET

PT1 cont

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2846909
Y -045885



Dry, brown and orange brown, CLAYEY SANDY SILT. *Residual.*

NOTES:
1. Bottom of hole at 6,0 m. Gravels and highly weathered rock encountered at the bottom of the excavation.
2. Co-ordinates determined from Garmin hand-held GPS to (WGS 84) system.

Contractor: -
Machine: -

Profiled by: MC Shuping
Date profiled: 17-Jul-21

▽ Water seepage
▼ Standing water
■ Undisturbed sample
● Disturbed sample
I Bulk sample
⊢⊣ *In-situ* test

Ref: 2172/g

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2041

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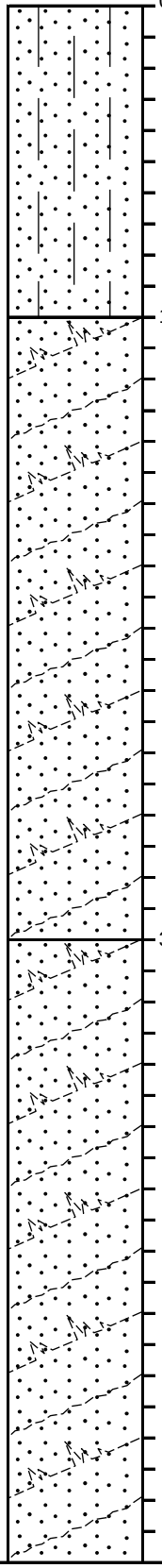
PROFILE SHEET

PT2

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2847032
Y -045978



0.0 – 1.0: Dry, light brown, SILTY SAND. *Hillwash/Aeolian?*

1.0 – 3.0: Dry, brown, shattered, CLAYEY SAND. *Alluvium.*

3.0 – : Dry, brown, shattered, CLAYEY SAND/SANDY CLAY. *Alluvium.*

Contains abundant quartz GRAVELS and COBBLES at base.

Contractor: -
Machine: -

Profiled by: MC Shuping
Date profiled: 17-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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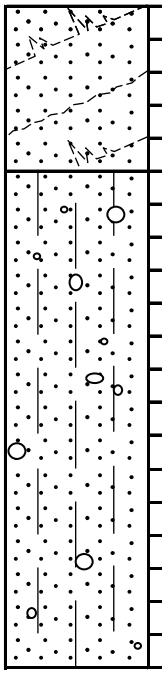
PROFILE SHEET

PT2 cont

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2847032
Y -045978



Dry, orange brown, SILTY SAND with scattered gravels. *Residual?*

NOTES:
1. Bottom of hole at 7,0 m. Gravels and highly weathered rock encountered at the bottom of the excavation.
2. Co-ordinates determined from Garmin hand-held GPS to (WGS 84) system.

Contractor: -
Machine: -

Profiled by: MC Shuping
Date profiled: 17-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

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CIVIL ENGINEERS

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2041

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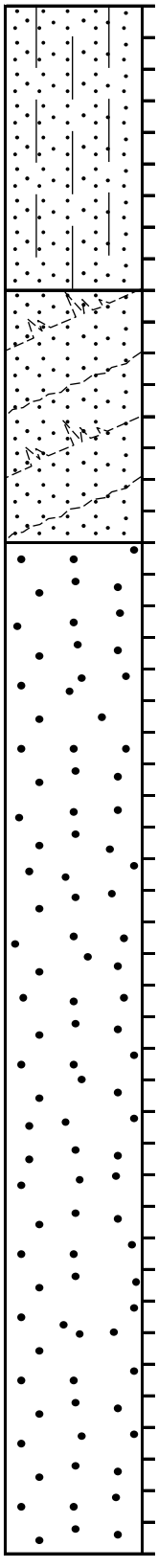
e-mail: admin@inroads-sa.co.za

PROFILE SHEET

PT3

Epoch Resources (Pty) Ltd
Tharisa Far West Waste Rock Dump

X 2847040
Y -046180



0.0 – 0.9: Dry, light brown, SILTY SAND. *Hillwash.*

0.9 – 1.7: Dry, brown, shattered, CLAYEY SAND with abundant ferruginous nodules. *Alluvium.*

1.7 – 5.0: Clast supported, sub-rounded and rounded, ferruginous NODULES in a matrix of clayey sand. *Nodular ferricrete.*

Grades to weak hardpan ferricrete.

NOTES:
1. Bottom of hole at 5,0 m. Weakly cemented ferricrete encountered at the bottom of the excavation.
2. Co-ordinates determined from Garmin hand-held GPS to (WGS 84) system.

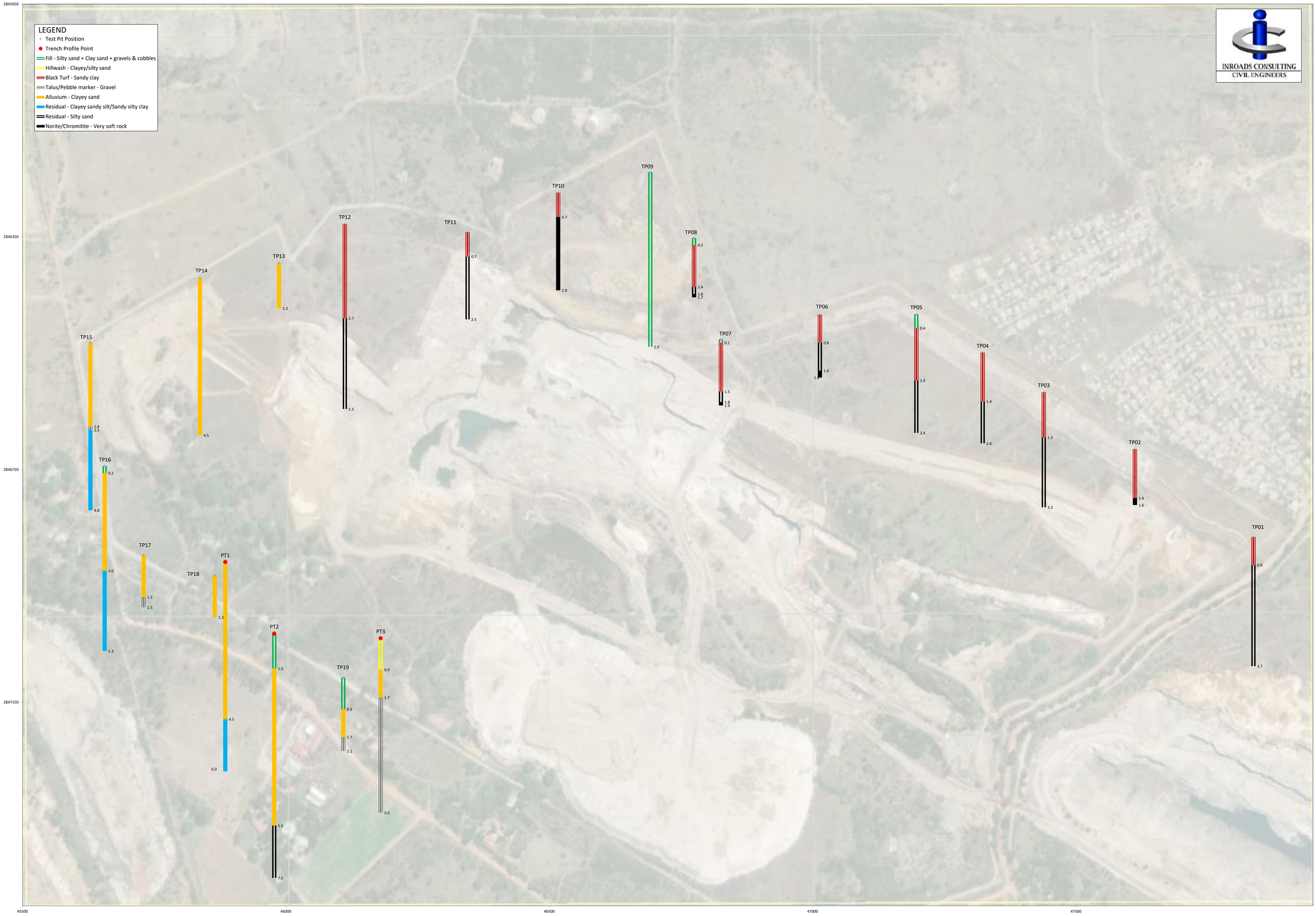
Contractor: -
Machine: -

Profiled by: MC Shuping
Date profiled: 17-Jul-21

Water seepage
Standing water
Undisturbed sample
Disturbed sample
Bulk sample
In-situ test

Ref: 2172/g

Summary of Profiles - Tharisa FW WRD2



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CIVIL ENGINEERS

APPENDIX E

Photographs of Test Pits

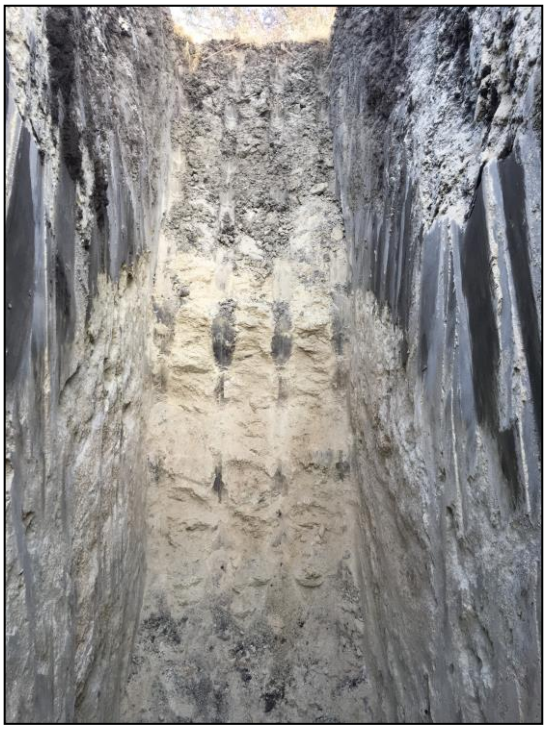
TEST PIT PHOTOGRAPHS	
SITE NAME: Tharisa FW WRD	
PHOTOGRAPH **1**	
Comments: TP01	
PHOTOGRAPH **2**	
Comments: TP02	

TEST PIT PHOTOGRAPHS	
SITE NAME: Tharisa FW WRD	
PHOTOGRAPH **3**	
Comments: TP03	
PHOTOGRAPH **4**	
Comments: TP04	

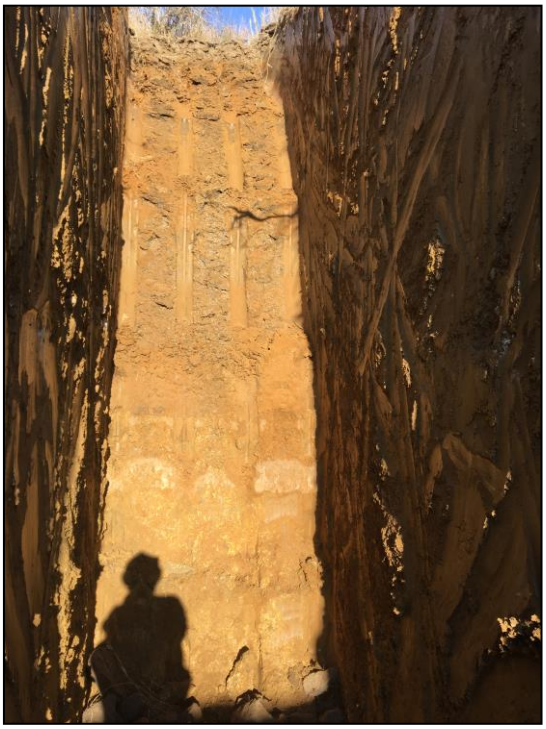
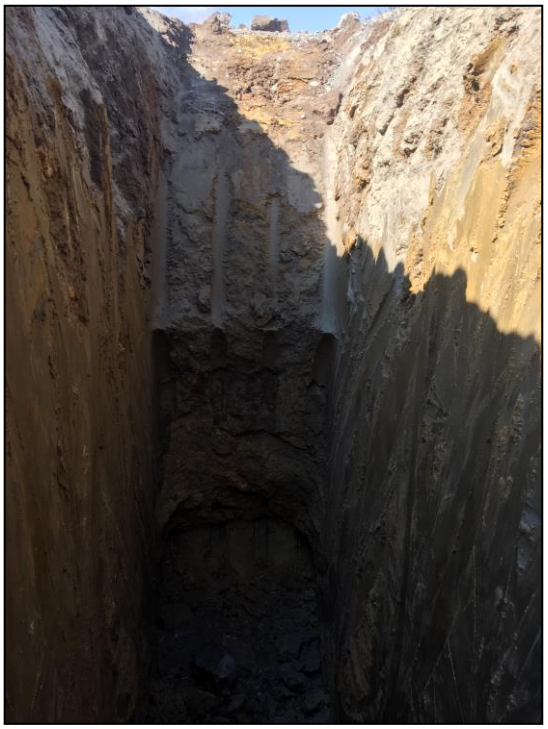
TEST PIT PHOTOGRAPHS	
SITE NAME: Tharisa FW WRD	
PHOTOGRAPH **5**	
Comments: TP05	
PHOTOGRAPH **6**	
Comments: TP06	

TEST PIT PHOTOGRAPHS	
SITE NAME: Tharisa FW WRD	
PHOTOGRAPH **7**	
Comments: TP07	
PHOTOGRAPH **8**	
Comments: TP08	

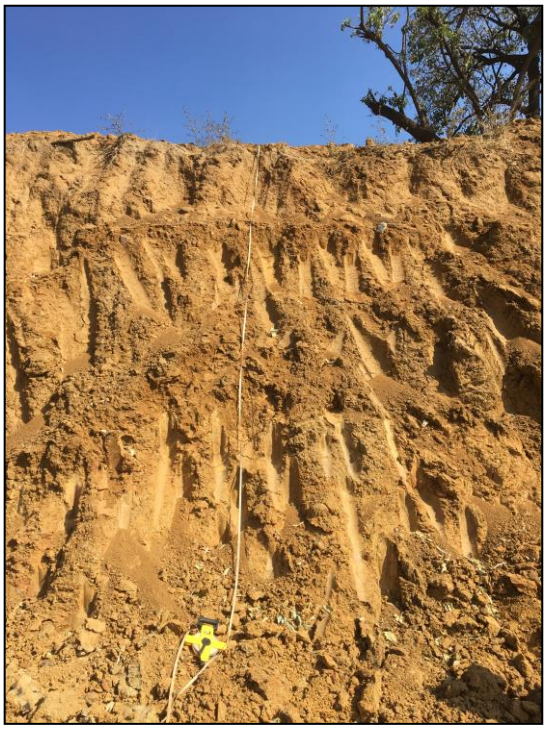
TEST PIT PHOTOGRAPHS	
SITE NAME: Tharisa FW WRD	
PHOTOGRAPH **9**	
Comments: TP09	
PHOTOGRAPH **10**	
Comments: TP10	

TEST PIT PHOTOGRAPHS	
SITE NAME: Tharisa FW WRD	
PHOTOGRAPH **11**	
Comments: TP11	
PHOTOGRAPH **12**	
Comments: TP12	

TEST PIT PHOTOGRAPHS	
SITE NAME: Tharisa FW WRD	
PHOTOGRAPH **13**	
Comments: TP13	
PHOTOGRAPH **14**	
Comments: TP14	

TEST PIT PHOTOGRAPHS	
SITE NAME: Tharisa FW WRD	
PHOTOGRAPH **15**	
Comments: TP15	
PHOTOGRAPH **16**	
Comments: TP16	

TEST PIT PHOTOGRAPHS	
SITE NAME: Tharisa FW WRD	
PHOTOGRAPH **17**	
Comments: TP17	
PHOTOGRAPH **18**	
Comments: TP18	

TEST PIT PHOTOGRAPHS	
SITE NAME: Tharisa FW WRD	
PHOTOGRAPH **19**	
Comments: TP19	
PHOTOGRAPH **20**	
Comments: PT1	

TEST PIT PHOTOGRAPHS	
SITE NAME: Tharisa FW WRD	
PHOTOGRAPH **21**	
Comments: PT2	
PHOTOGRAPH **22**	
Comments: PT3	

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CIVIL ENGINEERS

APPENDIX F

Laboratory Test Results

SGS MATROLAB (PTY) LTD
- CIVIL ENGINEERING SERVICES -
Reg.No.: 2003/021980/07 - VAT. Reg.No.: 4040210587
a SANAS Accredited Testing Laboratory, No. T0025

256 Brander Street,Jan Niemand Park,Pretoria.
P.O Box 912387,Silverton,0127
Tel. : (012) 800 1299
Fax :
Email : martinus.schwartz@sgs.com

sanas Testing Laboratory T0025

TEST RESULTS

EPOCH RESOURCES

Attention: Mr Stephan Brakhuizen

Project : Tharisa FW WRD2

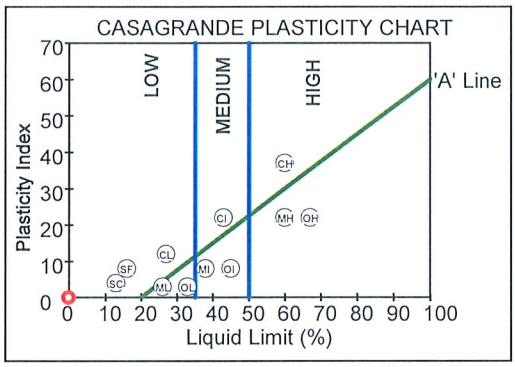
Your Ref :
Our Ref : PL/45639
Date Reported : 21.09.2021

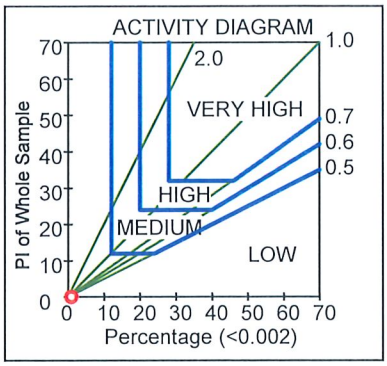
FOUNDATION INDICATOR (ASTM: D422)

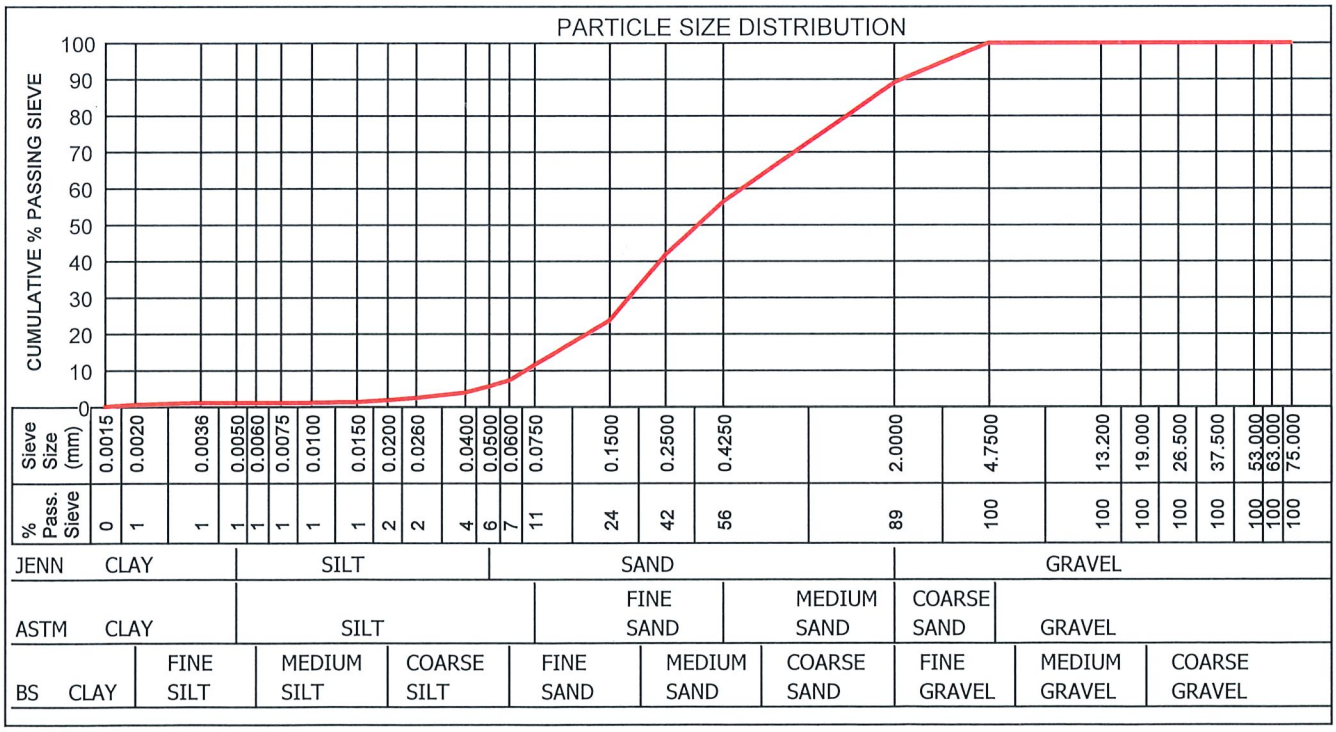
Sample No.	: A21/2950(G21-0564
Hole No.	: TP01
Depth	: 2100-2400
Liquid Limit (%)	: -
Plasticity Index	: NP
Linear Shrinkage (%)	: 0.0
PI of Whole Sample	: 0
P.R.A. Classification	: A-2-4(0)
Unified Soil Classificati	: SW-SC
Activity	: 0.00
Heave Classification	: LOW
Grading Modulus	: 1.44
Percentage (<0.002)	: 1.0
Moisture Content (%)	: 15.8

Material Description : SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	1.1	4.4	83.6	10.9	SAND
Astm	1.1	10.3	88.6	0.0	SAND
British Standard	0.6	6.7	81.9	10.9	SAND







Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	0	1	1	1	1	1	1	1	2	2	4	6	7	11	24	42	56	89	100	100	100	100	100	100	100	100

JENN	CLAY	SILT			SAND			GRAVEL		
ASTM	CLAY	SILT			FINE SAND		MEDIUM SAND	COARSE SAND	GRAVEL	
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL

Remarks : Sampled by client.

FORM: A6

4.4.1(SGS)(2019.12.04)

Technical Signatory : Martinus Schwartz/Lizette Breiting

SGS MATROLAB (PTY) LTD
- CIVIL ENGINEERING SERVICES -
Reg.No.: 2003/021980/07 - VAT. Reg.No.: 4040210587
a SANAS Accredited Testing Laboratory, No. T0025

256 Brander Street,Jan Niemand Park,Pretoria.
P.O Box 912387,Silverton,0127
Tel. : (012) 800 1299
Fax :
Email : martinus.schwartz@sgs.com

sanas Testing Laboratory T0025

TEST RESULTS

EPOCH RESOURCES

Attention: Mr Stephan Brakhuizen

Project : Tharisa FW WRD2

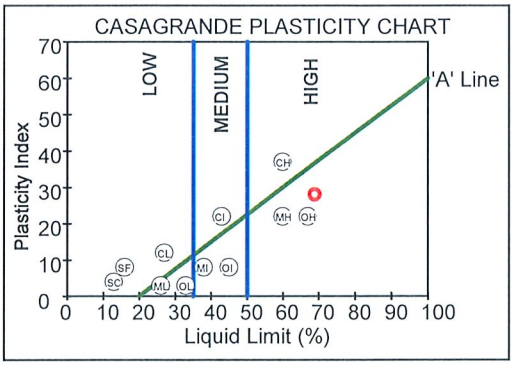
Your Ref :
Our Ref : PL/45639
Date Reported : 21.09.2021

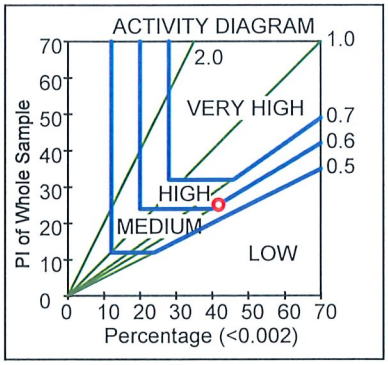
FOUNDATION INDICATOR (ASTM: D422)

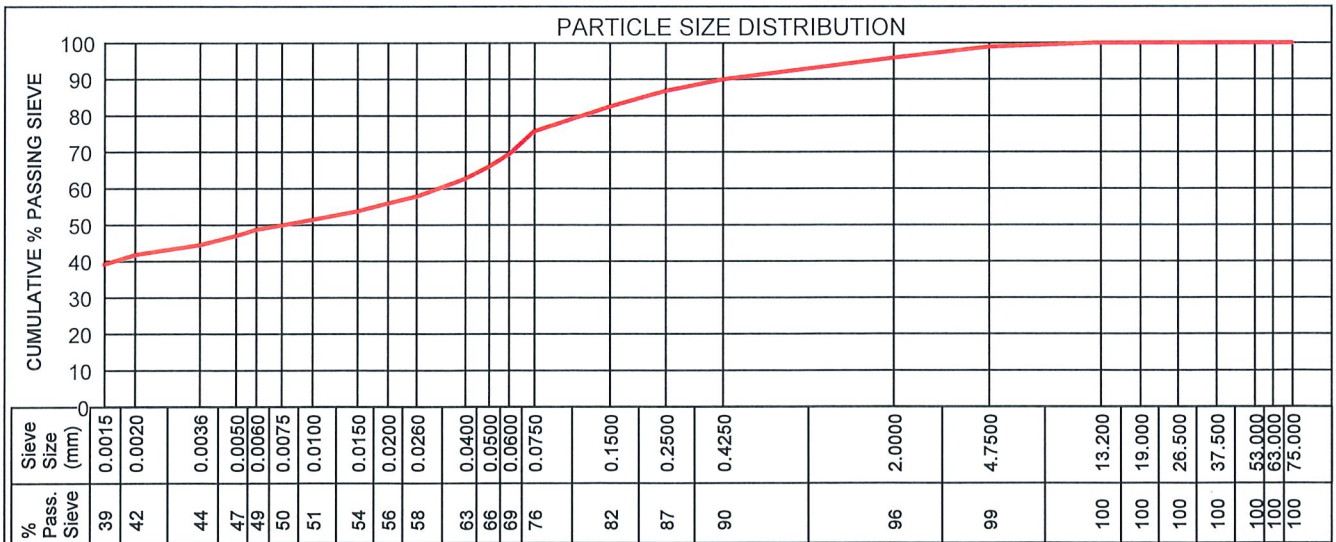
Sample No. : A21/2951(G21-0565
Hole No. : TP05
Depth : 1000-1300
Liquid Limit (%) : 69
Plasticity Index : 28
Linear Shrinkage (%) : 13.0
PI of Whole Sample : 25
P.R.A. Classification : A-7-5(19)
Unified Soil Classificati: MH
Activity : 0.60
Heave Classification : HIGH
Grading Modulus : 0.38
Percentage (<0.002) : 42.0
Moisture Content (%) : 29.5

Material Description : SILTY CLAY

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	47.0	19.0	29.8	4.2	SANDY CLAY
Astm	47.0	28.6	23.2	1.2	SILTY CLAY
British Standard	41.7	27.7	26.4	4.2	SILTY CLAY







Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	39	42	44	47	49	50	51	54	56	58	63	66	69	76	82	87	90	96	99	100	100	100	100	100	100	100

JENN	CLAY		SILT			SAND			GRAVEL	
ASTM	CLAY		SILT			FINE SAND		MEDIUM SAND	COARSE SAND	GRAVEL
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL

Remarks : Sampled by client.

FORM: A6

4.4.1(SGS)(2019.12.04)

Technical Signatory : Martinus Schwartz/Lizette Breiting

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- CIVIL ENGINEERING SERVICES -
Reg.No.: 2003/021980/07 - VAT. Reg.No.: 4040210587
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Email : martinus.schwartz@sgs.com

sanas Testing Laboratory T0025

TEST RESULTS

EPOCH RESOURCES

Attention: Mr Stephan Brakhuizen

Project : Tharisa FW WRD2

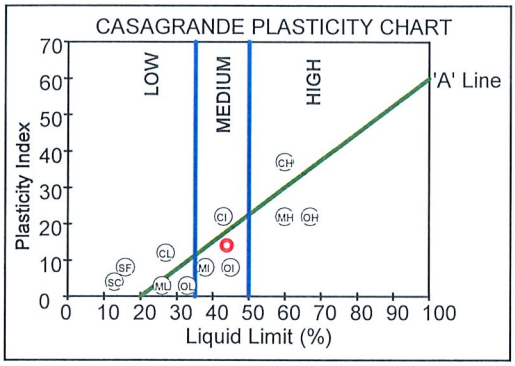
Your Ref :
Our Ref : PL/45639
Date Reported : 21.09.2021

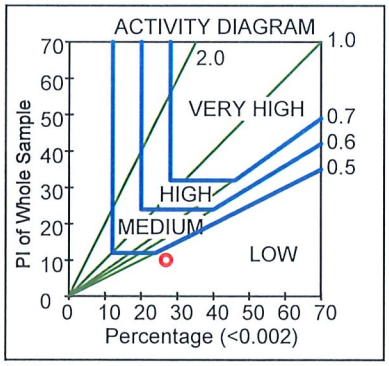
FOUNDATION INDICATOR (ASTM: D422)

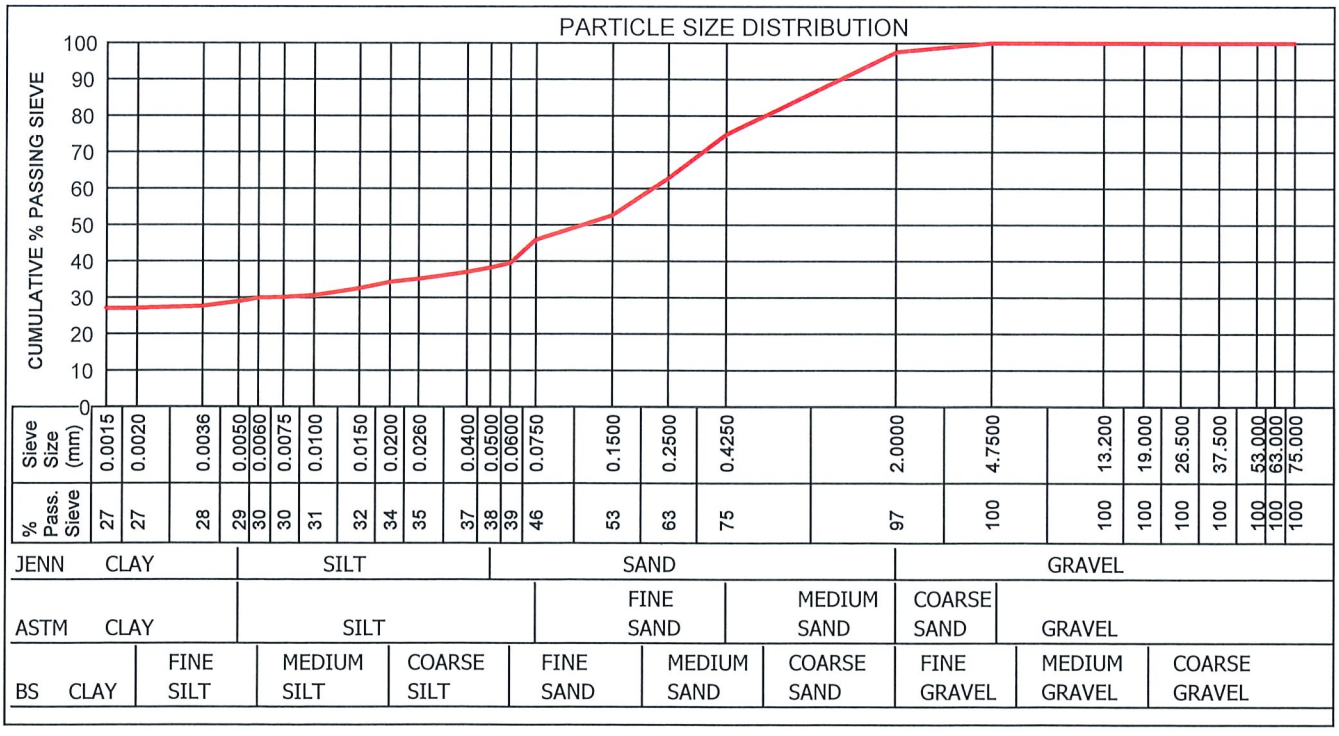
Sample No.	: A21/2952(G21-0566
Hole No.	: TP14
Depth	: 3100-3400
Liquid Limit (%)	: 44
Plasticity Index	: 14
Linear Shrinkage (%)	: 7.0
PI of Whole Sample	: 10
P.R.A. Classification	: A-7-5(4)
Unified Soil Classificati	: SM
Activity	: 0.37
Heave Classification	: LOW
Grading Modulus	: 0.82
Percentage (<0.002)	: 27.0
Moisture Content (%)	: 13.0

Material Description : CLAYEY SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	28.9	9.3	59.3	2.5	CLAYEY SAND
Astm	28.9	16.9	54.3	0.0	CLAYEY SAND
British Standard	27.0	12.5	58.0	2.5	CLAYEY SAND







Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	27	27	28	29	30	30	31	32	34	35	37	38	39	46	53	63	75	97	100	100	100	100	100	100	100	100

JENN	CLAY		SILT			SAND			GRAVEL		
ASTM	CLAY		SILT			FINE SAND		MEDIUM SAND	COARSE SAND	GRAVEL	
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL	

Remarks : Sampled by client.

FORM: A6

4.4.1(SGS)(2019.12.04)

Technical Signatory : Martinus Schwartz/Lizette Breiting

MATROLAB IS NOW PART OF SGS, THE WORLDS`S LEADING INSPECTION, VERFICATION, TESTING AND CERTIFICATION COMPANY.

SGS MATROLAB (PTY) LTD
- CIVIL ENGINEERING SERVICES -
Reg.No.: 2003/021980/07 - VAT. Reg.No.: 4040210587
a SANAS Accredited Testing Laboratory, No. T0025

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Email : martinus.schwartz@sgs.com

sanas Testing Laboratory T0025

TEST RESULTS

EPOCH RESOURCES

Attention: Mr Stephan Brakhuizen

Project : Tharisa FW WRD2

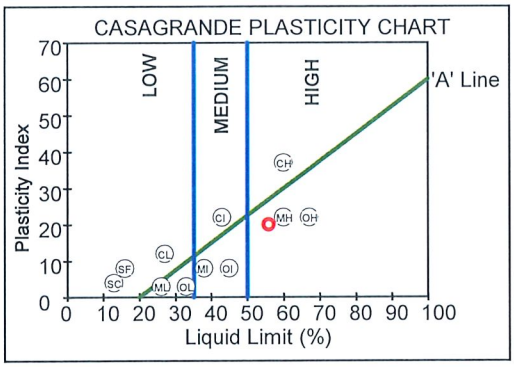
Your Ref :
Our Ref : PL/45639
Date Reported : 21.09.2021

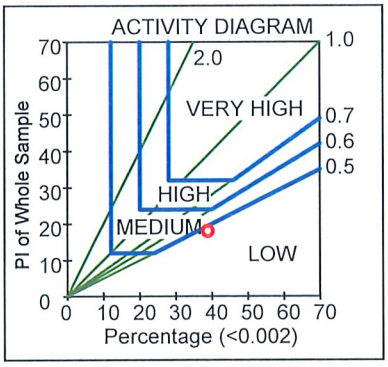
FOUNDATION INDICATOR (ASTM: D422)

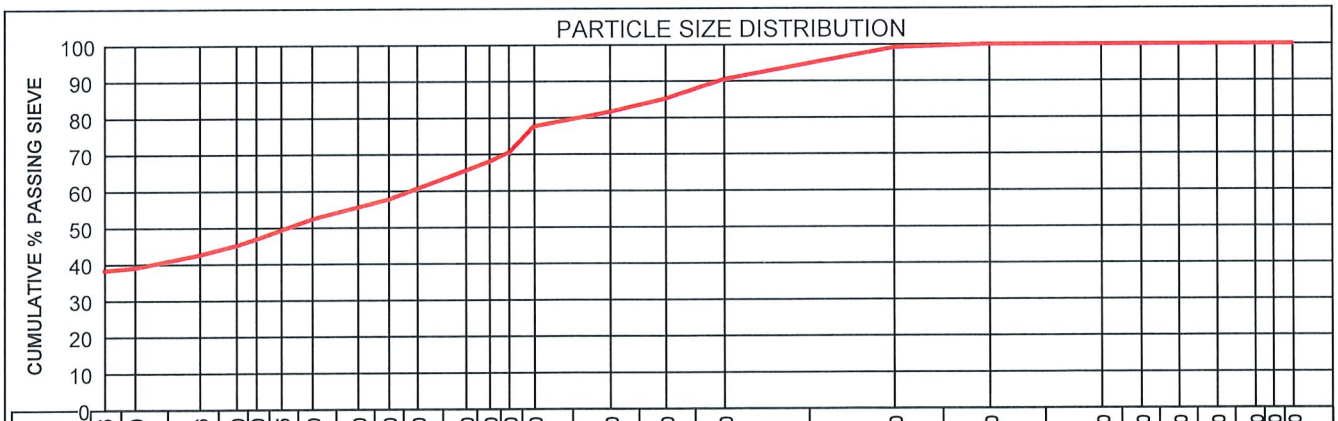
Sample No.	: A21/2953(G21-0567
Hole No.	: TP15
Depth	: 3200-3500
Liquid Limit (%)	: 56
Plasticity Index	: 20
Linear Shrinkage (%)	: 9.0
PI of Whole Sample	: 18
P.R.A. Classification	: A-7-5(15)
Unified Soil Classificati	: MH
Activity	: 0.46
Heave Classification	: LOW
Grading Modulus	: 0.33
Percentage (<0.002)	: 39.0
Moisture Content (%)	: 22.9

Material Description : SILTY CLAY

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	45.1	22.9	31.1	0.9	SANDY CLAY
Astm	45.1	32.5	22.4	0.0	SILTY CLAY
British Standard	39.1	31.5	28.5	0.9	SILTY CLAY







Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	38	39	43	45	47	49	52	56	58	61	65	68	71	78	82	85	90	99	100	100	100	100	100	100	100	100

JENN	CLAY		SILT			SAND			GRAVEL	
ASTM	CLAY		SILT			FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL	
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL

Remarks : Sampled by client.

FORM: A6

4.4.1(SGS)(2019.12.04)

Technical Signatory : Martinus Schwartz/Lizette Breiting

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Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Inroads Consulting
Project Name: Tharisa TSF - FW WRD2
Job Number: IRC-18
Date: 2021-09-15
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TP05		TP12	Sample	TP05		TP12
Depth (m)	1.9 - 3.4		2.7 - 5.0	Depth (m)	1.9 - 3.4		2.7 - 5.0
Lab No	IRC-18-158		IRC-18-160	Lab No	IRC-18-158		IRC-18-160
53.0	**100**		**100**	Liquid Limit (%)	**29**		**-**
37.5	**100**		**100**	Plastic Limit (%)	**21**		**-**
26.5	**100**		**100**	Plasticity Index (%)	**8**		**NP**
19.0	**100**		**100**	Linear Shrinkage (%)	**4.5**		**0.0**
13.2	**100**		**100**	PI of whole sample	**2**		**-**
9.5	**100**		**100**				
6.7	**96**		**100**	% Gravel	**47**		**16**
4.75	**88**		**100**	% Sand	**45**		**73**
2.00	**53**		**84**	% Silt	**6**		**10**
1.00	**37**		**60**	% Clay	**2**		**1**
0.425	**28**		**50**	Activity	**4.0**		**0.0**
0.250	**22**		**35**				
0.150	**16**		**24**	% Soil Mortar	**53**		**84**
0.075	**10**		**14**				
0.060	**8**		**11**	Grading Modulus	**2.09**		**1.52**
0.050	**7**		**10**	Moisture Content (%)	**N / T**		**N / T**
0.035	**5**		**7**	Relative Density (SG)*	**2.65**		**2.65**
0.020	**4**		**4**				
0.006	**2**		**2**	Unified (ASTM D2487)	**SW-SC**		**SM**
0.002	**2**		**1**	AASHTO (M145-91)	**A - 2 - 4**		**A - 1 - b**

Remarks: *: Assumed
N / T: Not Tested

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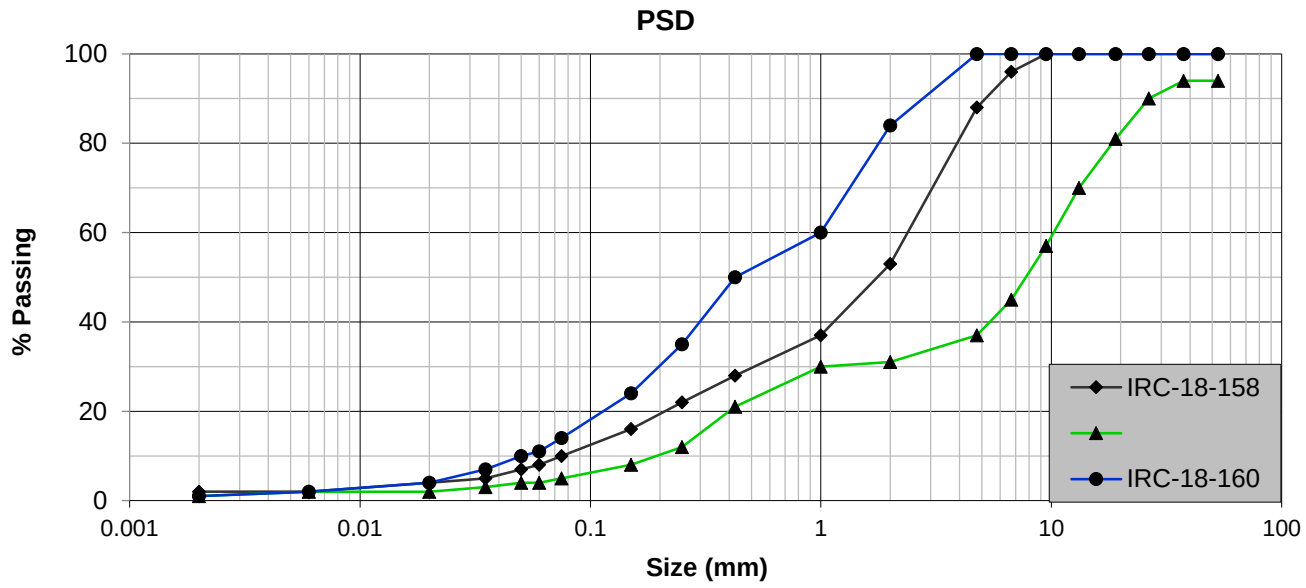
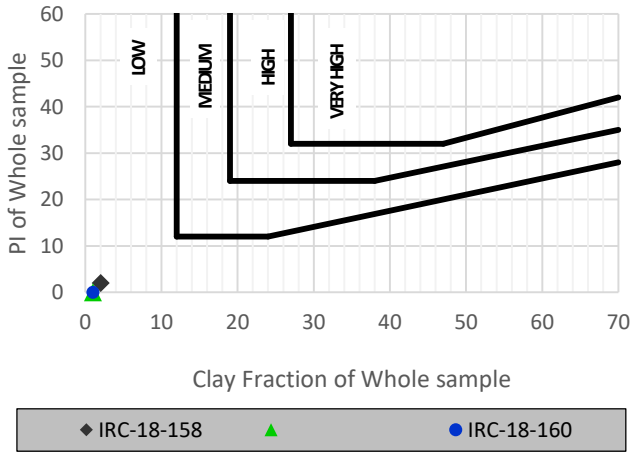
FOUNDATION INDICATOR

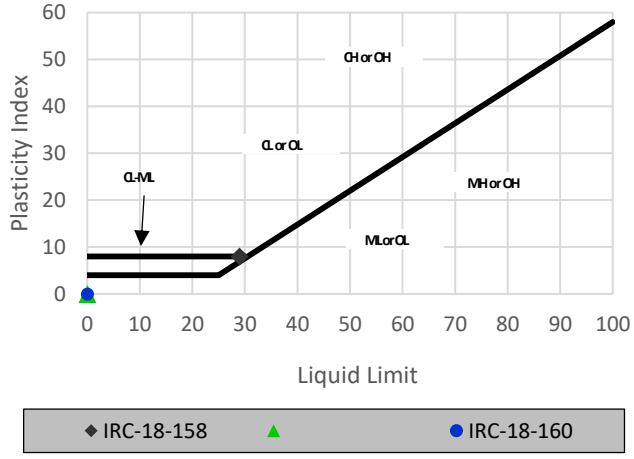
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



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FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis
(Particle Size (mm) & % Passing)

Sample	TP13	TP15
Depth (m)	0.4 - 1.3	2.5 - 3.0
Lab No	IRC-18-161	IRC-18-162
53.0	**100**	**100**
37.5	**100**	**100**
26.5	**100**	**100**
19.0	**100**	**100**
13.2	**100**	**100**
9.5	**100**	**100**
6.7	**100**	**100**
4.75	**100**	**99**
2.00	**100**	**96**
1.00	**97**	**92**
0.425	**72**	**83**
0.250	**52**	**75**
0.150	**41**	**70**
0.075	**31**	**65**
0.060	**27**	**61**
0.050	**25**	**59**
0.035	**22**	**54**
0.020	**20**	**51**
0.006	**19**	**47**
0.002	**18**	**44**

Atterberg Limits & Classification

Sample	TP13	TP15
Depth (m)	0.4 - 1.3	2.5 - 3.0
Lab No	IRC-18-161	IRC-18-162
Liquid Limit (%)	**34**	**49**
Plastic Limit (%)	**16**	**26**
Plasticity Index (%)	**18**	**23**
Linear Shrinkage (%)	**9.5**	**11.5**
PI of whole sample	**13**	**19**
% Gravel	**0**	**4**
% Sand	**73**	**35**
% Silt	**9**	**17**
% Clay	**18**	**44**
Activity	**1.0**	**0.5**
% Soil Mortar	**100**	**96**
Grading Modulus	**0.97**	**0.56**
Moisture Content (%)	**N / T**	**N / T**
Relative Density (SG)*	**2.65**	**2.65**
Unified (ASTM D2487)	**SC**	**CL**
AASHTO (M145-91)	**A - 2 - 6**	**A - 7 - 6**

Remarks: *: Assumed
N / T: Not Tested

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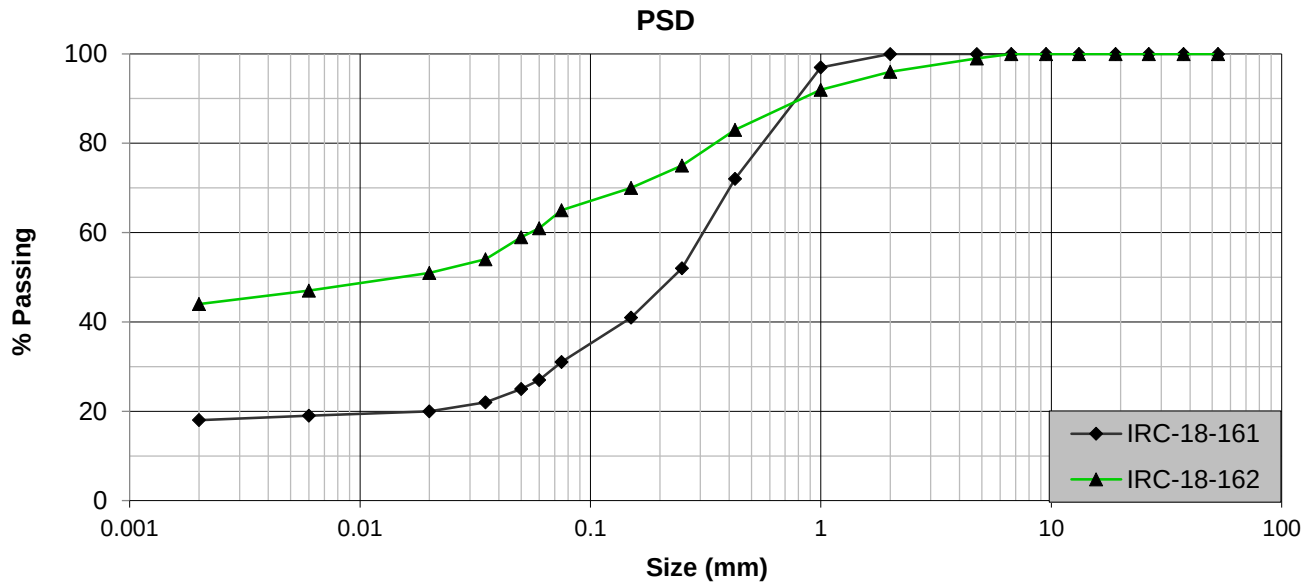
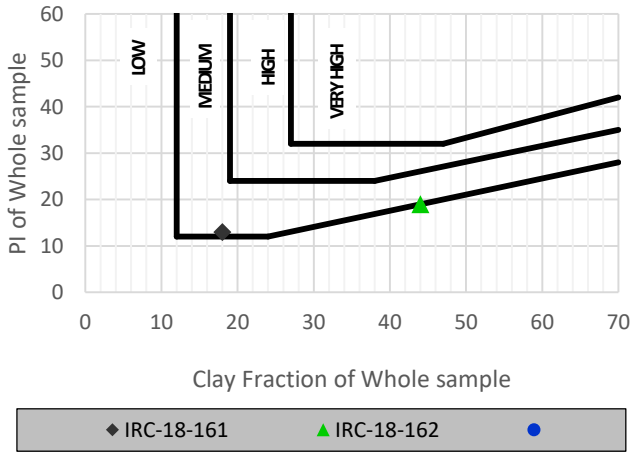
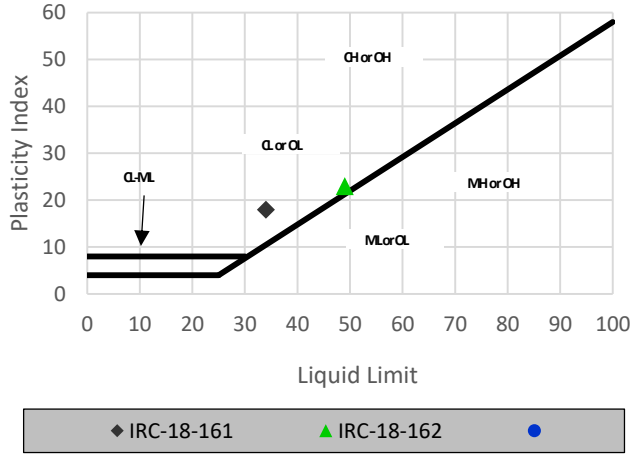
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



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CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD2 **Job no:** 39458

Sample no: TP 01 **Date:** 15/09/2021

Lab no: G21-0564 **Depth (m):** 2.1-2.4

Test Information		
Test Type	-	Consolidated Undrained with PWP measurements, saturated
Sample Condition	-	Remoulded
Saturation Method		Increments of Cell- and Backpressure
Consolidation Pressures	kPa	50, 100, 200
Rate of Strain	%/min	0.0104
Failure Criterion	-	Maximum Deviator Stress
Side Drains Used	-	No
Drainage Conditions	-	To One End
Comments	-	Test 1, Test 2 & Test 3 - Failure Criterion taken at Maximum Change in Pore Pressure
		-

Initial Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content	%	6.8	6.9	9.5	Complete test specimen
Dry Density	Kg/m³	1816	1811	1781	
Void Ratio	-	0.531	0.535	0.560	
Degree of Saturation	%	35.8	35.7	47.4	
Initial Height	cm	7.7	7.7	7.7	
Initial Diameter	cm	3.8	3.8	3.8	
Area (After Consolidation)	cm²	11.413	11.374	11.258	Calculated
Relative Density (SG)	-		2.779		Determined

Final Sample Parameters		Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content		%	19.8	19.8	20.8	Complete test specimen
Dry Density		Kg/m³	1826	1832	1817	
Void Ratio		-	0.522	0.517	0.530	
Area		cm²	13.557	13.484	13.374	Calculated
Eff. Consolidation Pressures		kPa	54	104	200	
Total Backpressure used		kPa	300	300	300	Saturation
Final B Parameter		-	0.98	1.00	0.98	
Cell Pressure		kPa	350	400	500	Consolidation & Shear
Axial Strain at Max. Deviator Stress		%	0.52	0.67	1.37	
Volume Change		ml	0.5	1.0	1.7	During Consolidation
Principal Stresses at Max. Deviator Stress	σ1	kPa	138	275	457	Corrected
	σ3	kPa	54	104	200	Corrected
	σ1'	kPa	119	235	373	Corrected
	σ3'	kPa	36	64	116	Corrected

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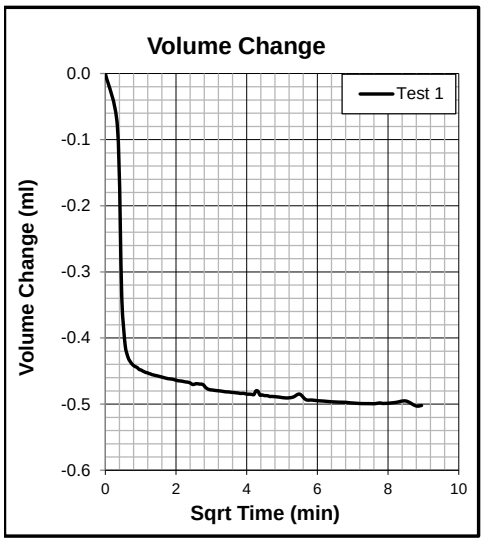
CONSOLIDATED UNDRAINED TRIAXIAL TEST

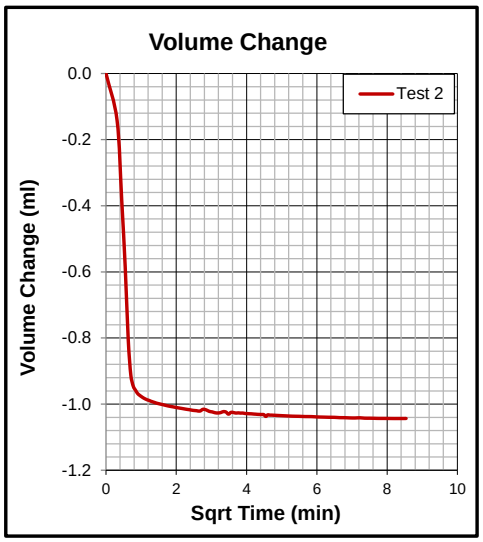
BS 1377 Part 8

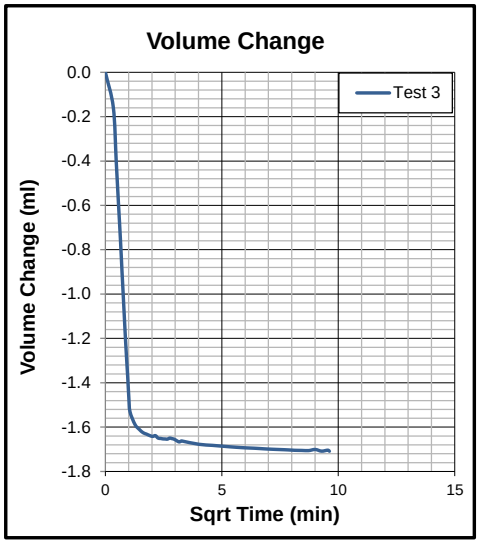
Client: EPOCH RESOURCES **Project:** THARISA FW WRD2 **Job no:** 39458

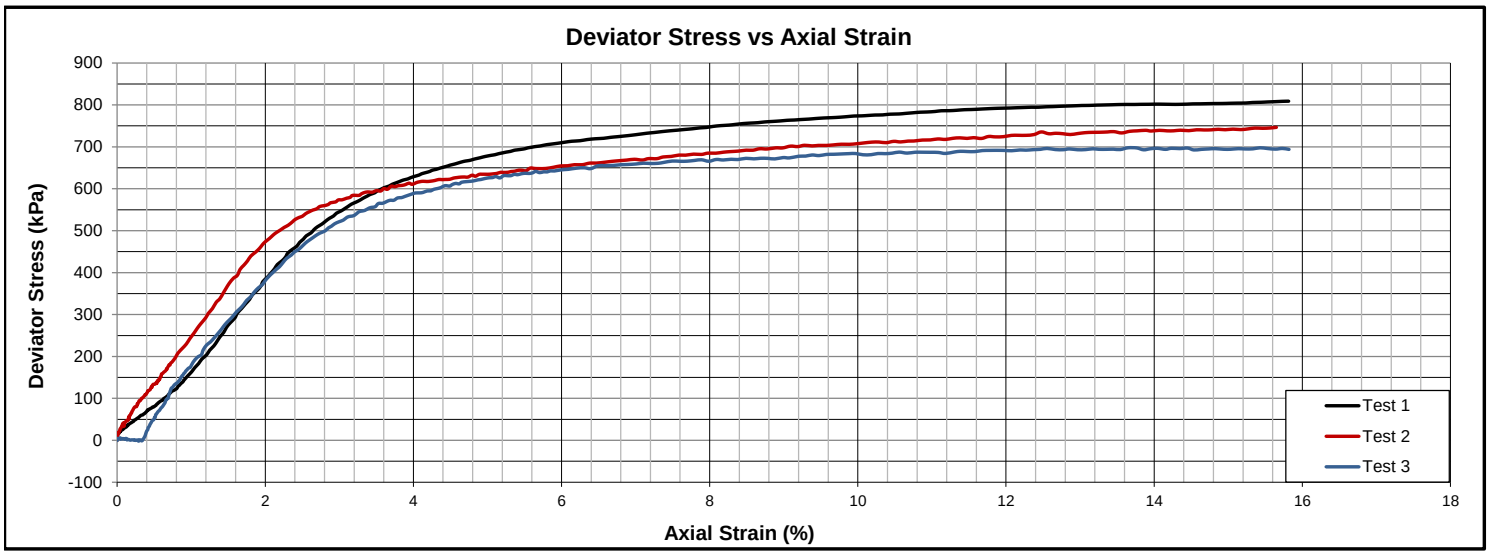
Sample no: TP 01 **Date:** 15/09/2021

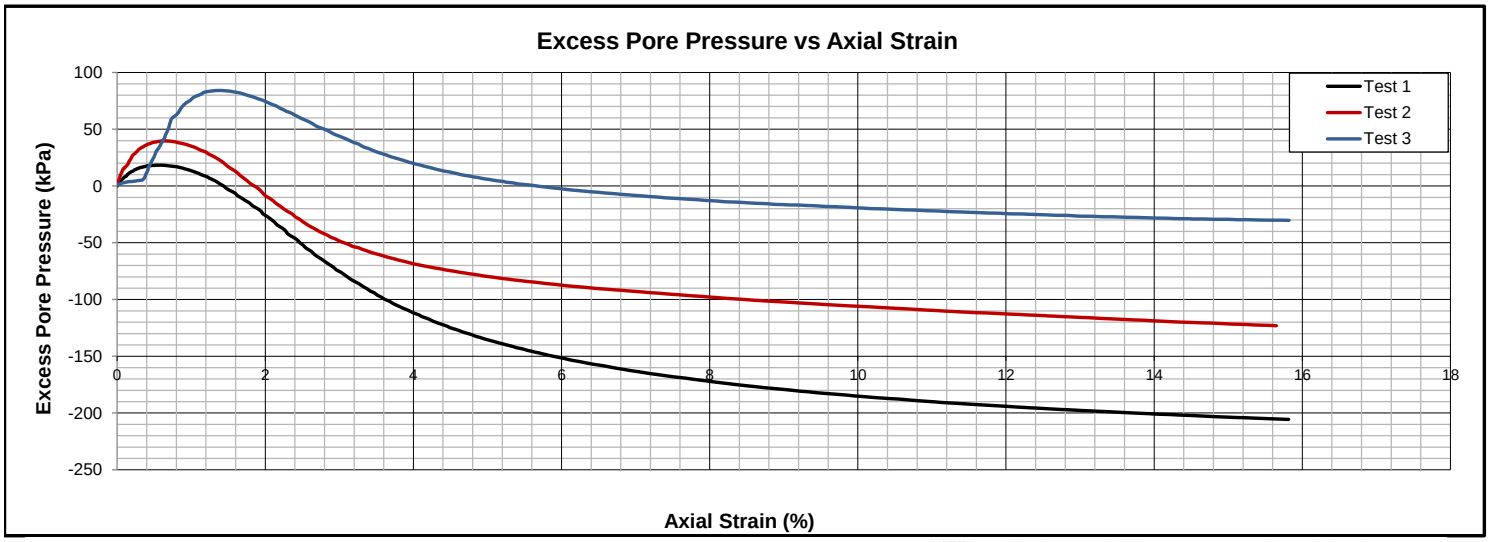
Lab no: G21-0564 **Depth (m):** 2.1-2.4 Sample Condition: Remoulded











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CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

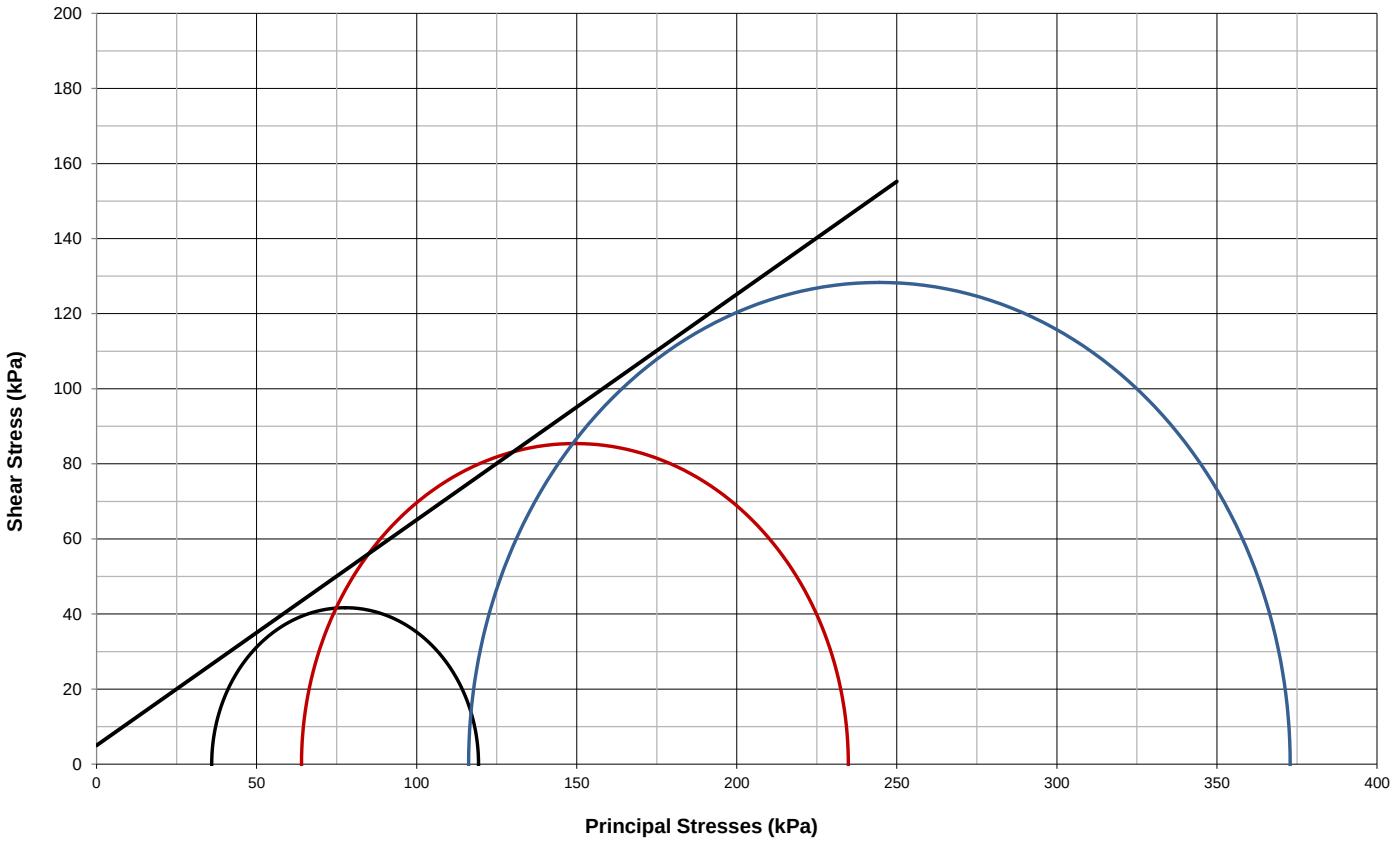
Client: EPOCH RESOURCES **Project:** THARISA FW WRD2 **Job no:** 39458

Sample no: TP 01 **Date:** 15/09/2021

Lab no: G21-0564 **Depth (m):** 2.1-2.4 Sample Condition: Remoulded

Shear Parameters of Effective Stresses		
Angle of Internal Friction	Deg.	**31**
Cohesion	kPa	**5**

Effective Shear Strength



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CONSOLIDATED UNDRAINED TRIAXIAL TEST

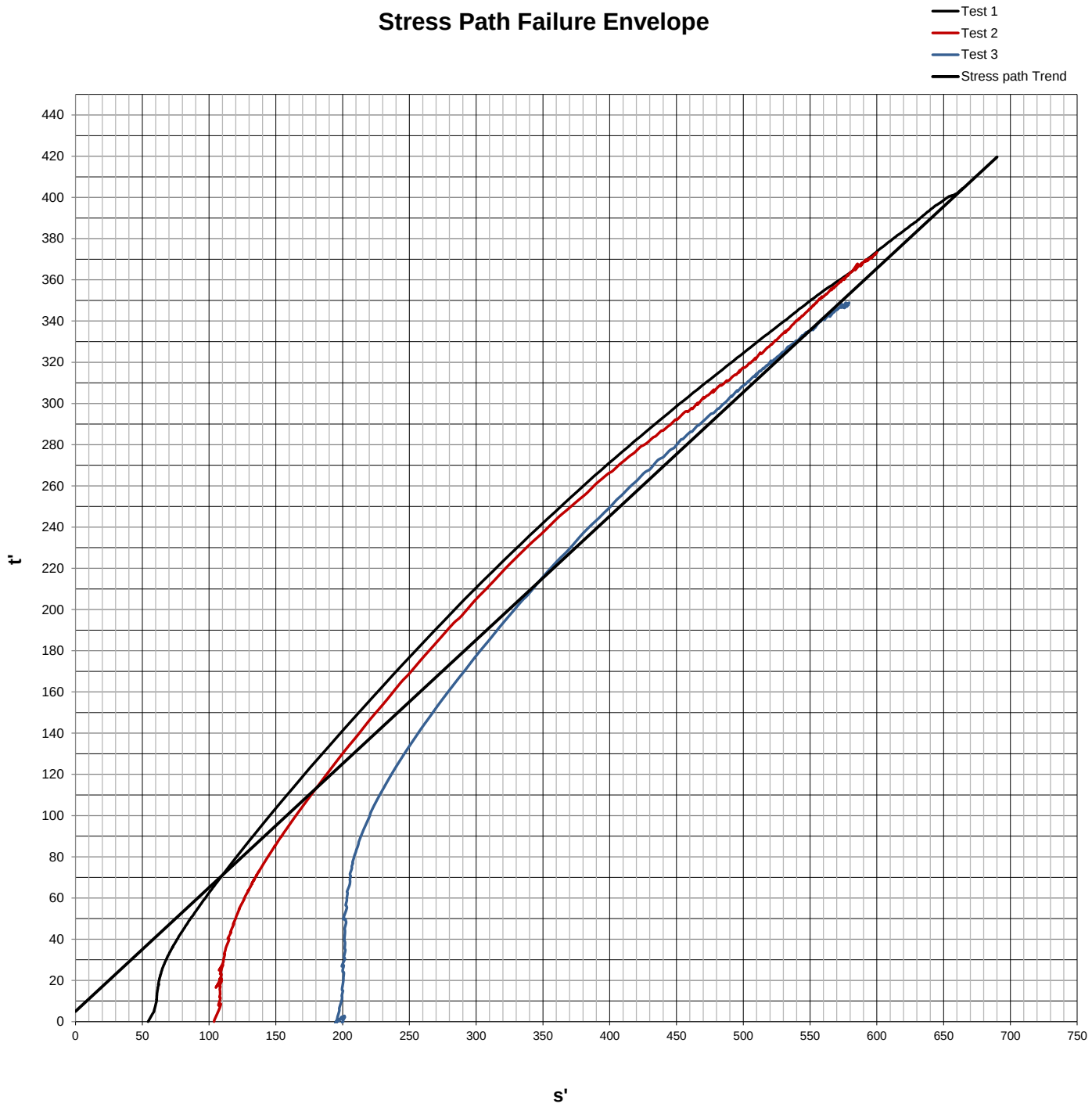
BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD2 **Job no:** 39458

Sample no: TP 01 **Date:** 15/09/2021

Lab no: G21-0564 **Depth (m):** 2.1-2.4 Sample Condition: Remoulded

Shear Parameters at Failure		
Angle of Internal Friction	Deg.	**31**
Cohesion	kPa	**5**



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CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD2 **Job no:** 39458

Sample no: TP 01 **Date:** 15/09/2021

Lab no: G21-0564 **Depth (m):** 2.1-2.4

Test 1

BEFOR TEST

AFTER TEST

Test 2

BEFOR TEST

AFTER TEST

Test 3

BEFOR TEST

AFTER TEST

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CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 05 **Depth (m):** 1.0-1.3 **Date:** 15/09/2021

Lab no: G21-0565

Test Information		
Test Type	-	Consolidated Undrained with PWP measurements, saturated
Sample Condition	-	Undisturbed
Saturation Method		Increments of Cell- and Backpressure
Consolidation Pressures	kPa	50, 100, 200
Rate of Strain	%/min	0.0104
Failure Criterion	-	Maximum Deviator Stress
Side Drains Used	-	Yes
Drainage Conditions	-	To One End
Comments	-	-
		-

Initial Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content	%	34.5	32.9	35.4	Complete test specimen
Dry Density	Kg/m³	1274	1291	1276	
Void Ratio	-	1.002	0.975	0.998	
Degree of Saturation	%	87.7	86.1	90.5	
Initial Height	cm	7.7	7.7	7.7	
Initial Diameter	cm	3.8	3.8	3.8	
Area (After Consolidation)	cm²	10.987	10.858	10.825	Calculated
Relative Density (SG)	-		2.550		Determined

Final Sample Parameters		Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content		%	38.4	35.2	36.0	Complete test specimen
Dry Density		Kg/m³	1304	1352	1381	
Void Ratio		-	0.956	0.886	0.847	
Area		cm²	13.060	12.912	12.928	Calculated
Eff. Consolidation Pressures		kPa	38	99	200	
Total Backpressure used		kPa	300	300	300	Saturation
Final B Parameter		-	0.98	0.96	0.96	
Cell Pressure		kPa	350	400	500	Consolidation & Shear
Axial Strain at Max. Deviator Stress		%	0.54	13.20	5.88	
Volume Change		ml	2.0	3.9	6.6	During Consolidation
Principal Stresses at Max. Deviator Stress	σ1	kPa	79	163	311	Corrected
	σ3	kPa	38	99	200	Corrected
	σ1'	kPa	69	118	229	Corrected
	σ3'	kPa	28	54	119	Corrected

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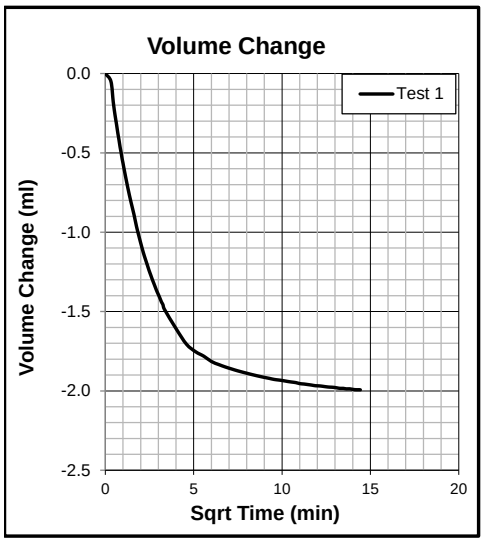
CONSOLIDATED UNDRAINED TRIAXIAL TEST

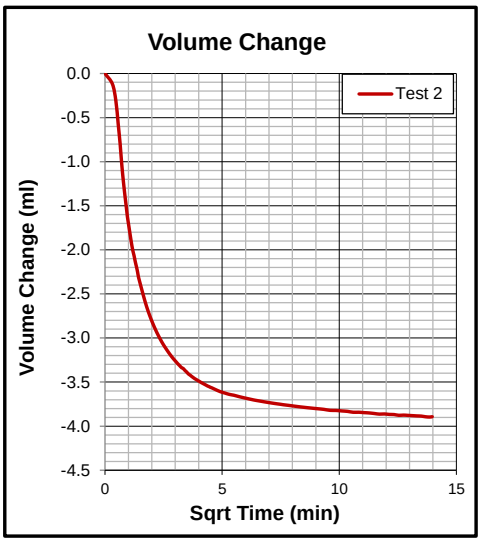
BS 1377 Part 8

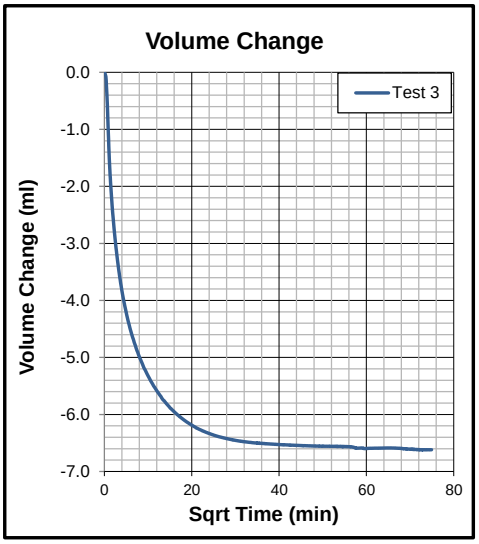
Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

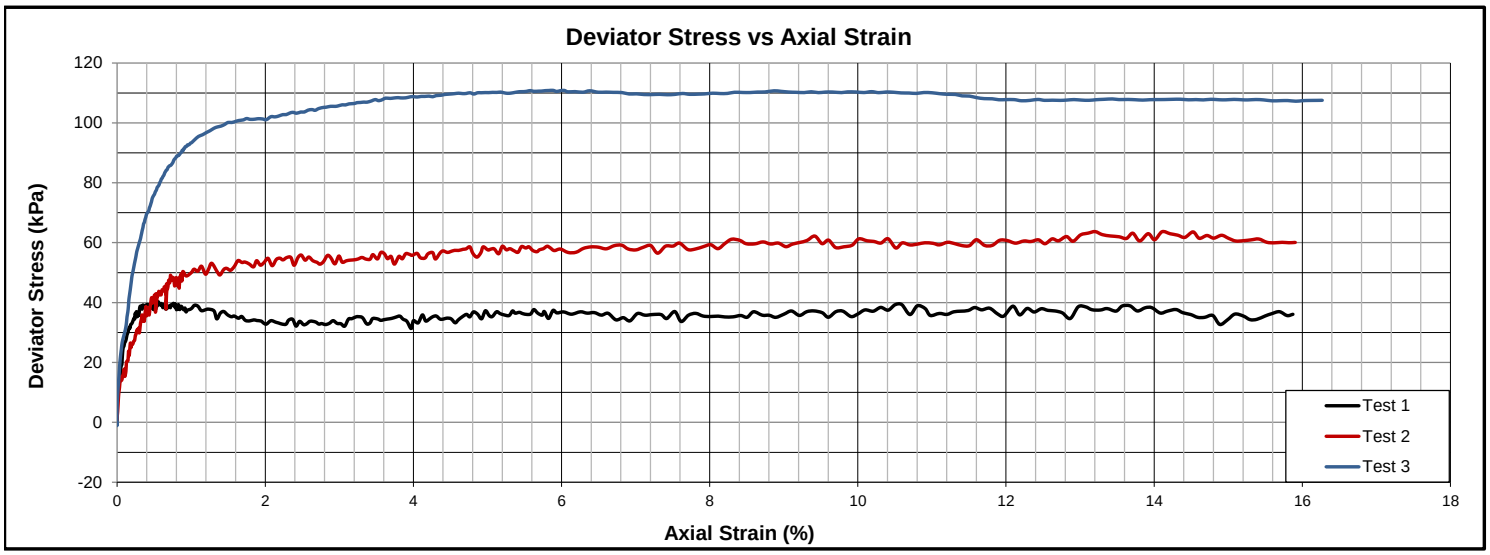
Sample no: TP 05 **Depth (m):** 1.0-1.3 **Date:** 15/09/2021

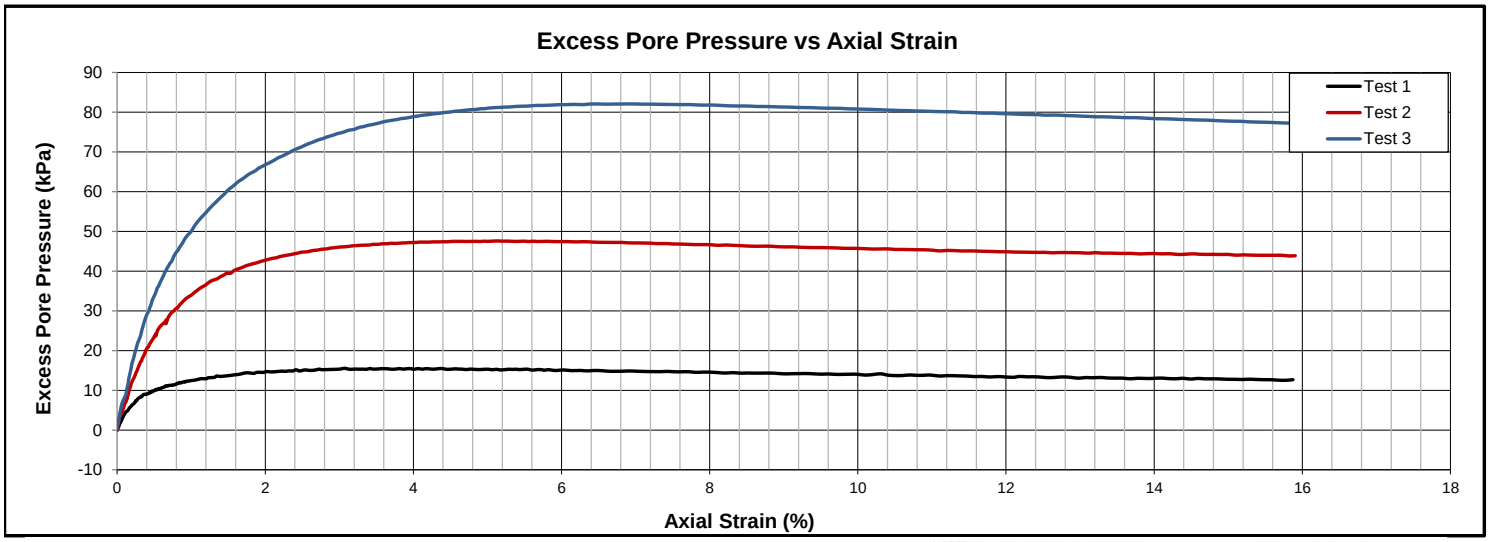
Lab no: G21-0565 Sample Condition: Undisturbed











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CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

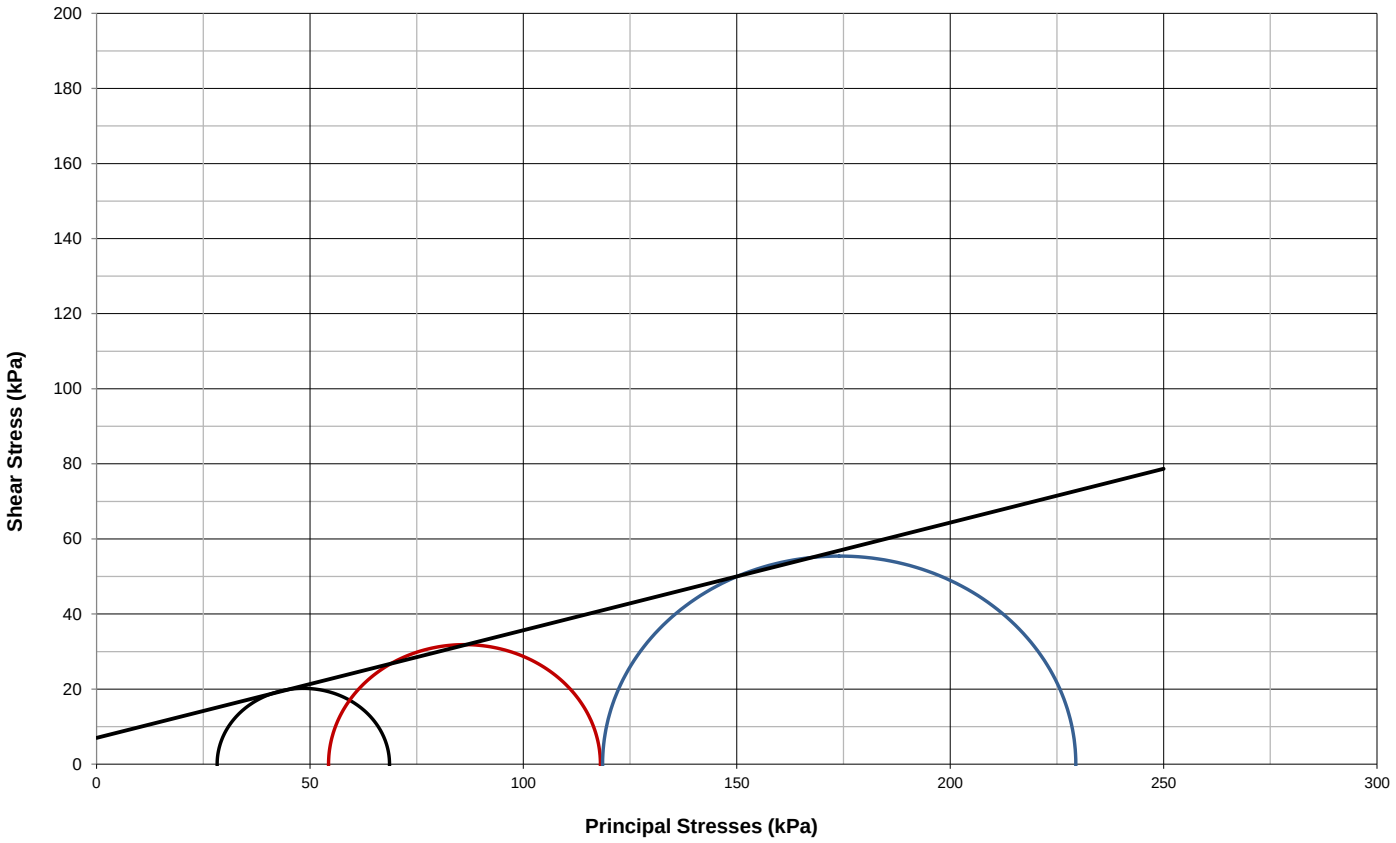
Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 05 **Depth (m):** 1.0-1.3 **Date:** 15/09/2021

Lab no: G21-0565 Sample Condition: Undisturbed

Shear Parameters of Effective Stresses		
Angle of Internal Friction	Deg.	**16**
Cohesion	kPa	**7**

Effective Shear Strength



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CONSOLIDATED UNDRAINED TRIAXIAL TEST

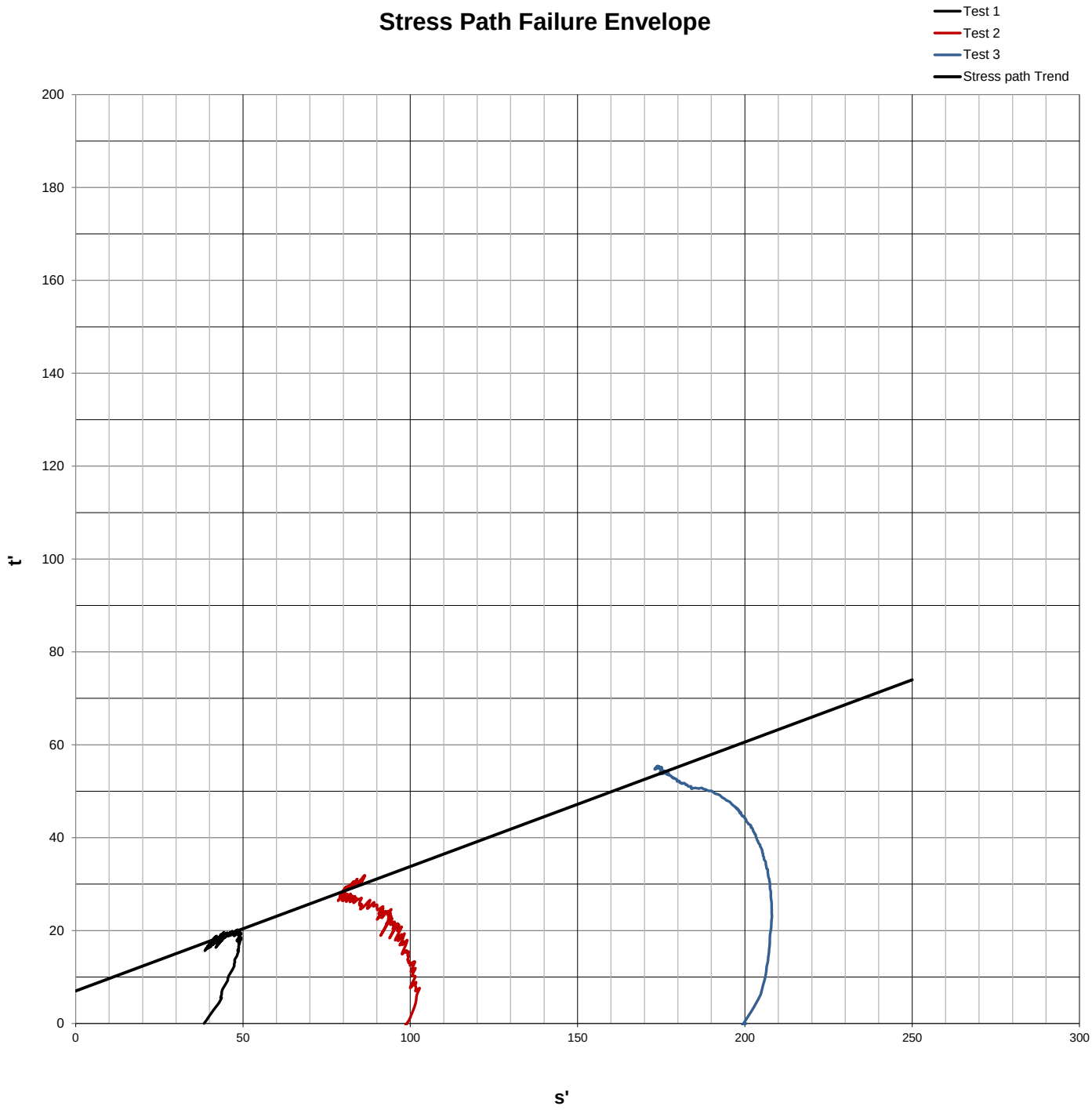
BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 05 **Depth (m):** 1.0-1.3 **Date:** 15/09/2021

Lab no: G21-0565 Sample Condition: Undisturbed

Shear Parameters at Failure		
Angle of Internal Friction	Deg.	**15**
Cohesion	kPa	**7**



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CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 05 **Depth (m):** 1.0-1.3 **Date:** 15/09/2021

Lab no: G21-0565

Test 1

BEFOR TEST

AFTER TEST

Test 2

BEFOR TEST

AFTER TEST

Test 3

BEFOR TEST

AFTER TEST

SGS MATROLAB

CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 14 **Depth (m):** 3.1-3.4 **Date:** 15/09/2021

Lab no: G21-0566

Test Information		
Test Type	-	Consolidated Undrained with PWP measurements, saturated
Sample Condition	-	Undisturbed
Saturation Method		Increments of Cell- and Backpressure
Consolidation Pressures	kPa	50, 100, 200
Rate of Strain	%/min	0.0104
Failure Criterion	-	Maximum Deviator Stress
Side Drains Used	-	Yes
Drainage Conditions	-	To One End
Comments	-	Test 1, Test 2 & Test 3 - Failure Criterion taken at Maximum Change in Pore Pressure
		-

Initial Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content	%	14.2	13.6	13.0	Complete test specimen
Dry Density	Kg/m³	1838	1865	1868	
Void Ratio	-	0.442	0.421	0.419	
Degree of Saturation	%	85.1	85.2	82.4	
Initial Height	cm	7.6	7.7	7.7	
Initial Diameter	cm	3.8	3.8	3.8	
Area (After Consolidation)	cm²	11.206	11.077	11.005	Calculated
Relative Density (SG)	-		2.651		Determined

Final Sample Parameters		Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content		%	18.2	17.5	16.7	Complete test specimen
Dry Density		Kg/m³	1866	1914	1962	
Void Ratio		-	0.421	0.385	0.351	
Area		cm²	11.361	11.303	11.343	Calculated
Eff. Consolidation Pressures		kPa	51	100	205	
Total Backpressure used		kPa	300	300	300	Saturation
Final B Parameter		-	0.98	0.96	0.96	
Cell Pressure		kPa	350	400	500	Consolidation & Shear
Axial Strain at Max. Deviator Stress		%	1.36	1.78	2.98	
Volume Change		ml	1.3	2.2	4.2	During Consolidation
Principal Stresses at Max. Deviator Stress	σ1	kPa	113	196	366	Corrected
	σ3	kPa	51	100	205	Corrected
	σ1'	kPa	94	150	282	Corrected
	σ3'	kPa	32	53	122	Corrected

SGS MATROLAB

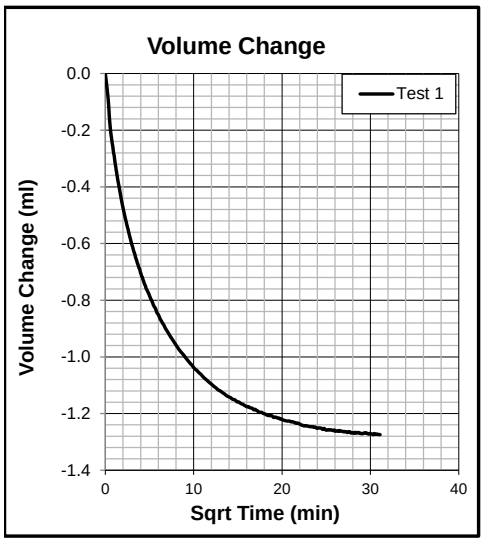
CONSOLIDATED UNDRAINED TRIAXIAL TEST

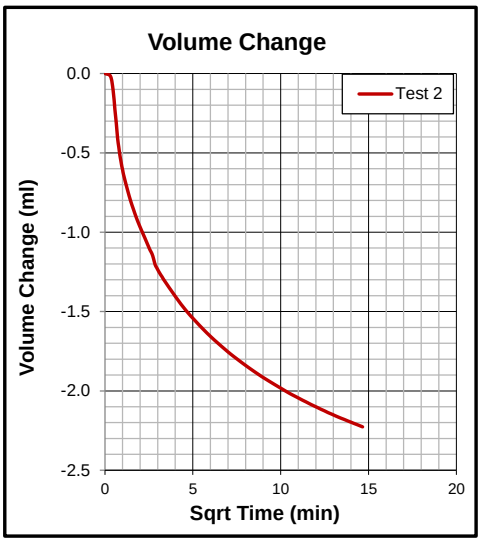
BS 1377 Part 8

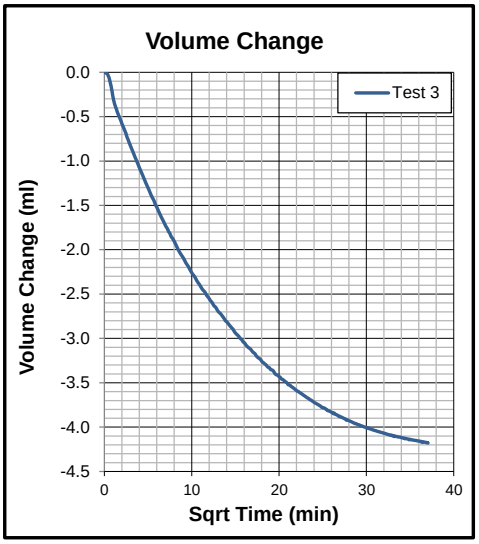
Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

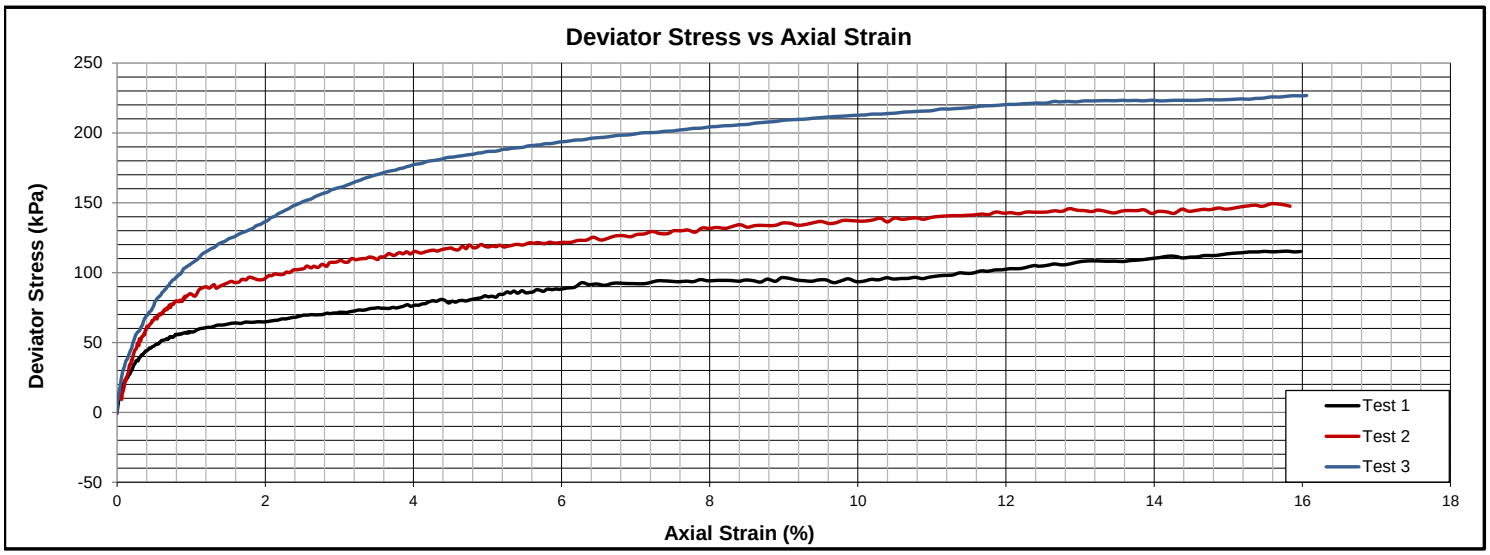
Sample no: TP 14 **Depth (m):** 3.1-3.4 **Date:** 15/09/2021

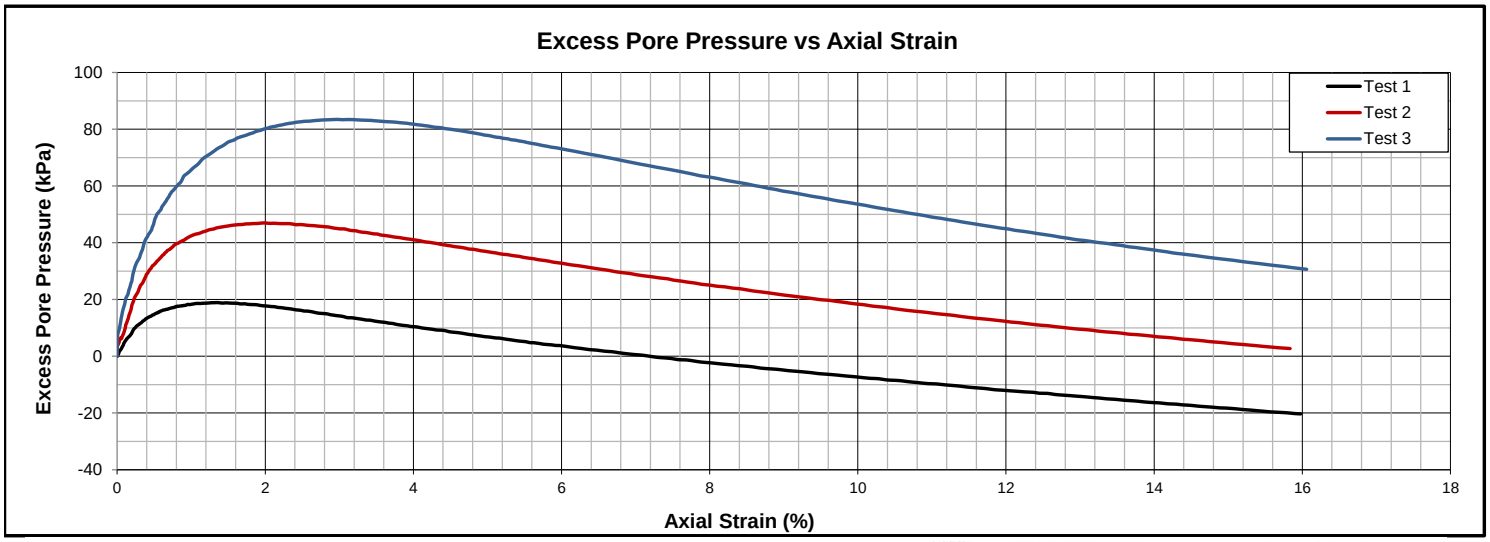
Lab no: G21-0566 Sample Condition: Undisturbed











SGS MATROLAB

CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

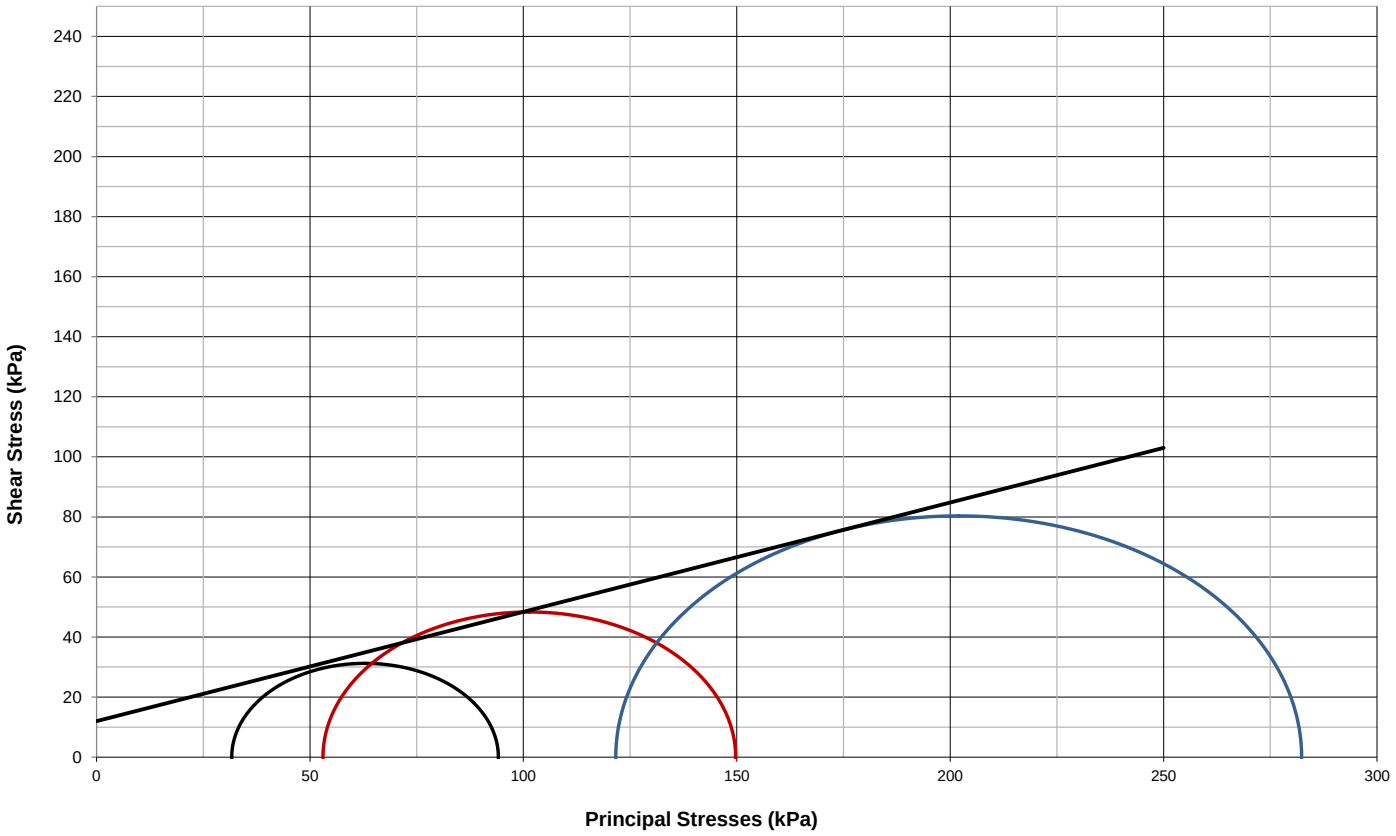
Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 14 **Depth (m):** 3.1-3.4 **Date:** 15/09/2021

Lab no: G21-0566 Sample Condition: Undisturbed

Shear Parameters of Effective Stresses		
Angle of Internal Friction	Deg.	**20**
Cohesion	kPa	**12**

Effective Shear Strength



SGS MATROLAB

CONSOLIDATED UNDRAINED TRIAXIAL TEST

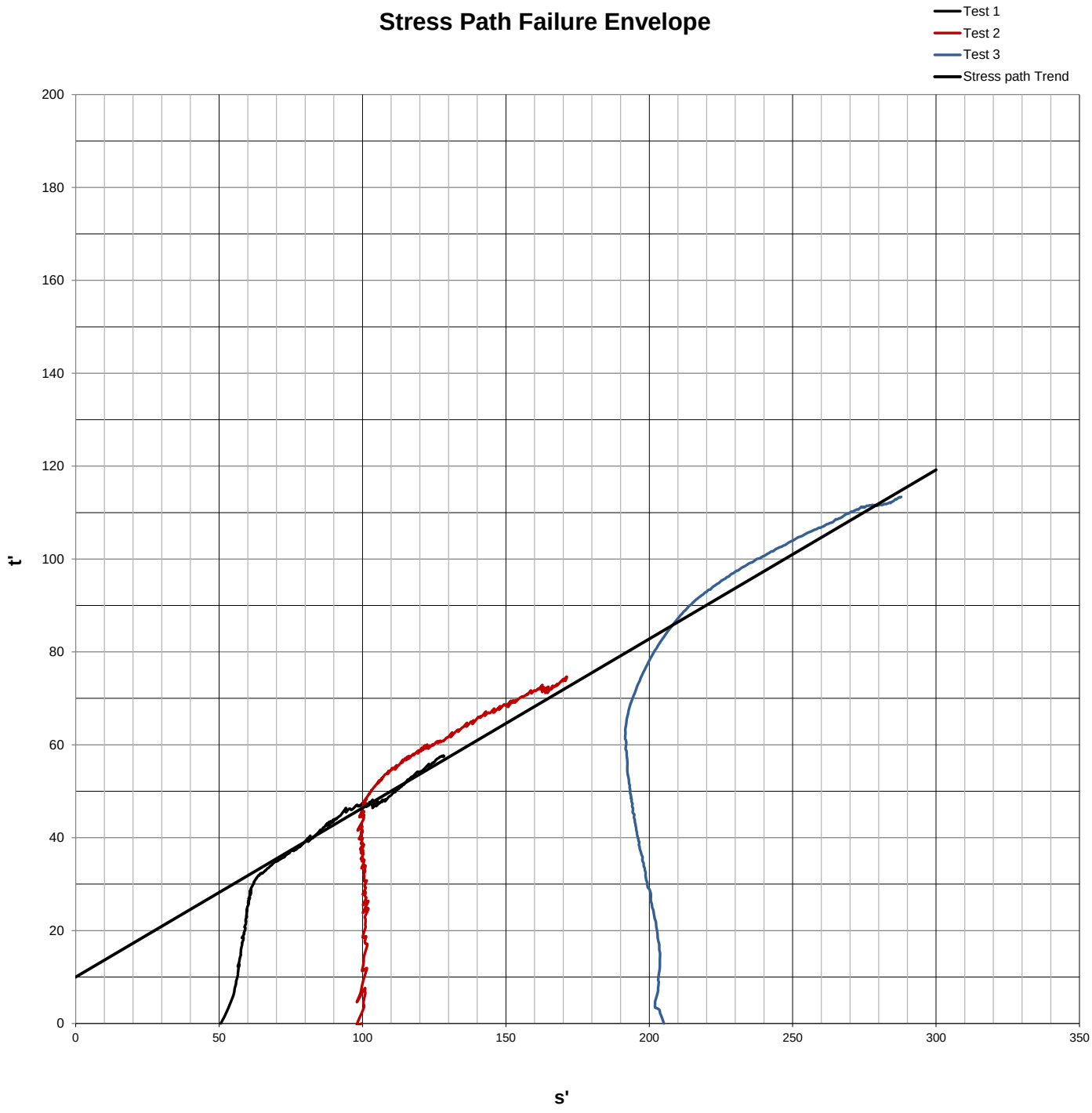
BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 14 **Depth (m):** 3.1-3.4 **Date:** 15/09/2021

Lab no: G21-0566 Sample Condition: Undisturbed

Shear Parameters at Failure		
Angle of Internal Friction	Deg.	**20**
Cohesion	kPa	**10**



SGS MATROLAB

CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 14 **Depth (m):** 3.1-3.4 **Date:** 15/09/2021

Lab no: G21-0566

Test 1

BEFOR TEST

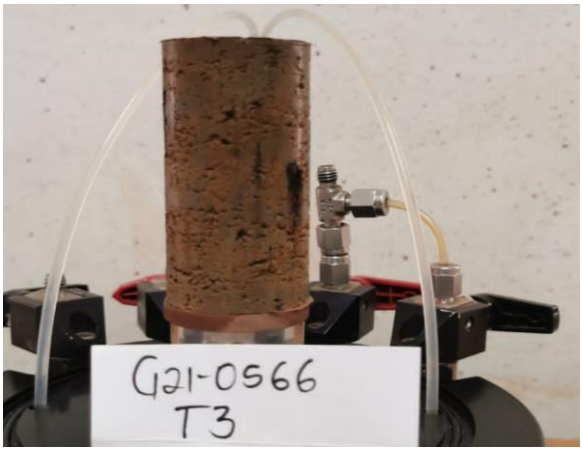
AFTER TEST

Test 2

BEFOR TEST

AFTER TEST

Test 3



BEFOR TEST

AFTER TEST

SGS MATROLAB

CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 15 **Depth (m):** 3.2-3.5 **Date:** 26/08/2021

Lab no: G21-0567

Test Information		
Test Type	-	Consolidated Undrained with PWP measurements, saturated
Sample Condition	-	Undisturbed
Saturation Method		Increments of Cell- and Backpressure
Consolidation Pressures	kPa	50, 100, 200
Rate of Strain	%/min	0.0104
Failure Criterion	-	Maximum Deviator Stress
Side Drains Used	-	Yes
Drainage Conditions	-	To One End
Comments	-	Test 1, Test 2 & Test 3 - Failure Criterion Taken at Maximum Change in Pore Pressure
		-

Initial Sample Parameters	Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content	%	26.6	24.6	25.4	Complete test specimen
Dry Density	Kg/m³	1414	1477	1448	
Void Ratio	-	0.882	0.801	0.838	
Degree of Saturation	%	80.3	81.6	80.7	
Initial Height	cm	7.6	7.7	7.6	
Initial Diameter	cm	3.8	3.8	3.8	
Area (After Consolidation)	cm²	11.226	11.245	11.104	Calculated
Relative Density (SG)	-		2.661		Determined

Final Sample Parameters		Unit	Test 1	Test 2	Test 3	Remarks
Moisture Content		%	31.9	29.0	29.5	Complete test specimen
Dry Density		Kg/m³	1435	1506	1493	
Void Ratio		-	0.854	0.767	0.782	
Area		cm²	13.366	13.366	13.230	Calculated
Eff. Consolidation Pressures		kPa	49	103	200	
Total Backpressure used		kPa	300	300	300	Saturation
Final B Parameter		-	0.98	0.98	0.98	
Cell Pressure		kPa	350	400	500	Consolidation & Shear
Axial Strain at Max. Deviator Stress		%	1.31	2.28	2.32	
Volume Change		ml	1.3	1.7	2.6	During Consolidation
Principal Stresses at Max. Deviator Stress	σ1	kPa	131	206	437	Corrected
	σ3	kPa	49	103	200	Corrected
	σ1'	kPa	103	148	329	Corrected
	σ3'	kPa	21	45	92	Corrected

SGS MATROLAB

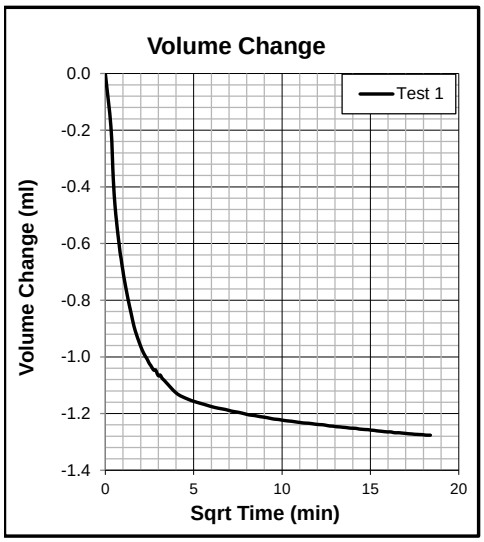
CONSOLIDATED UNDRAINED TRIAXIAL TEST

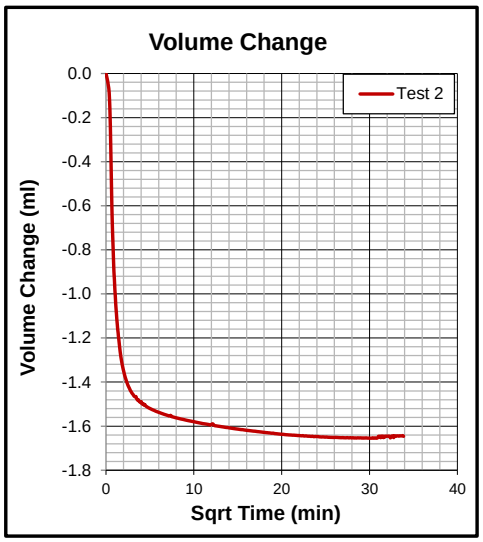
BS 1377 Part 8

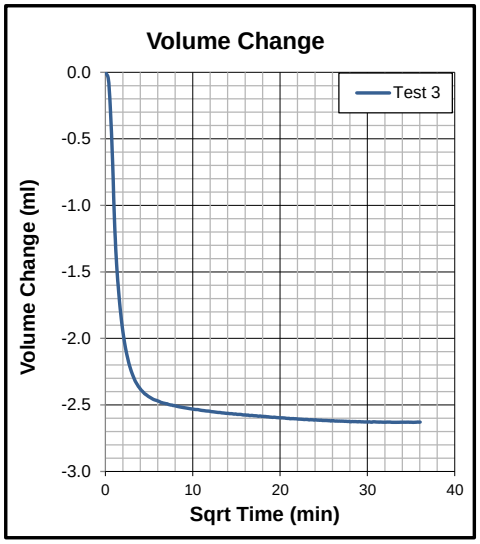
Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

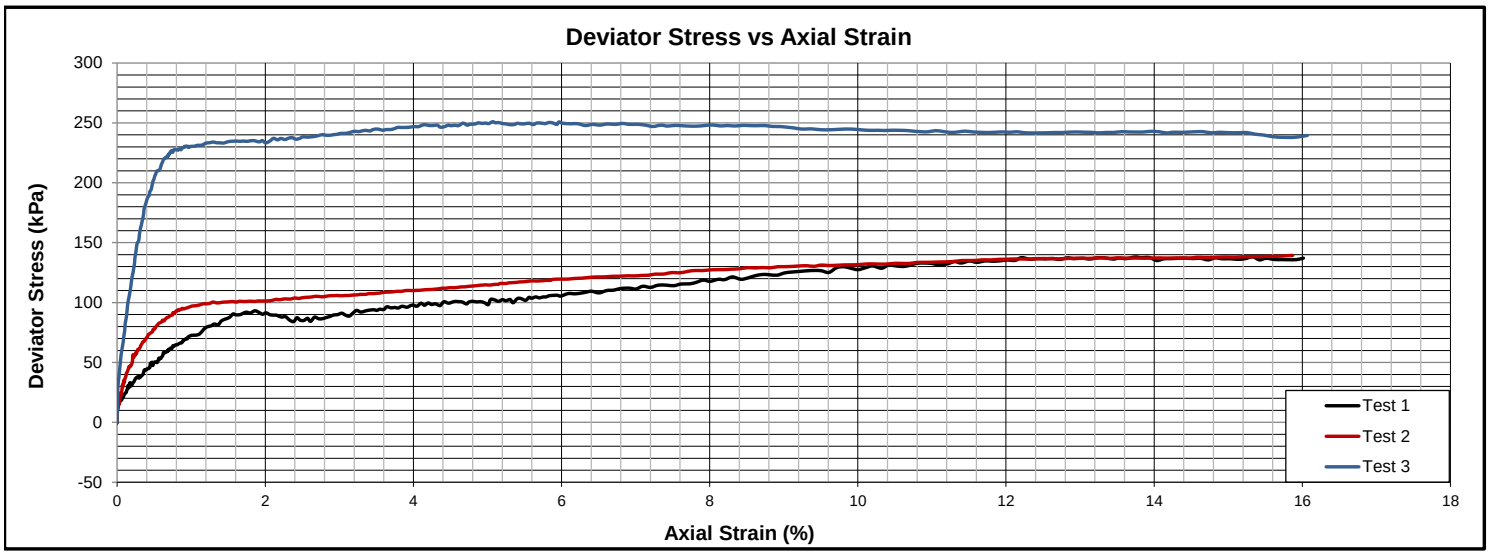
Sample no: TP 15 **Depth (m):** 3.2-3.5 **Date:** 26/08/2021

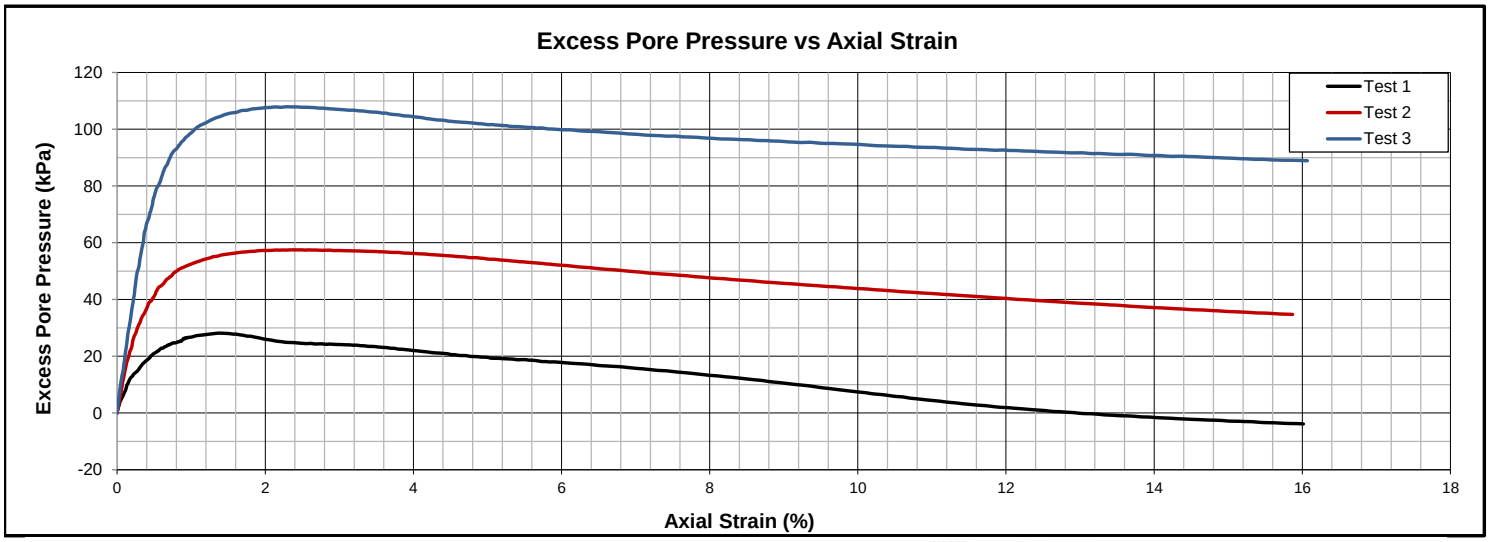
Lab no: G21-0567 Sample Condition: Undisturbed











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CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

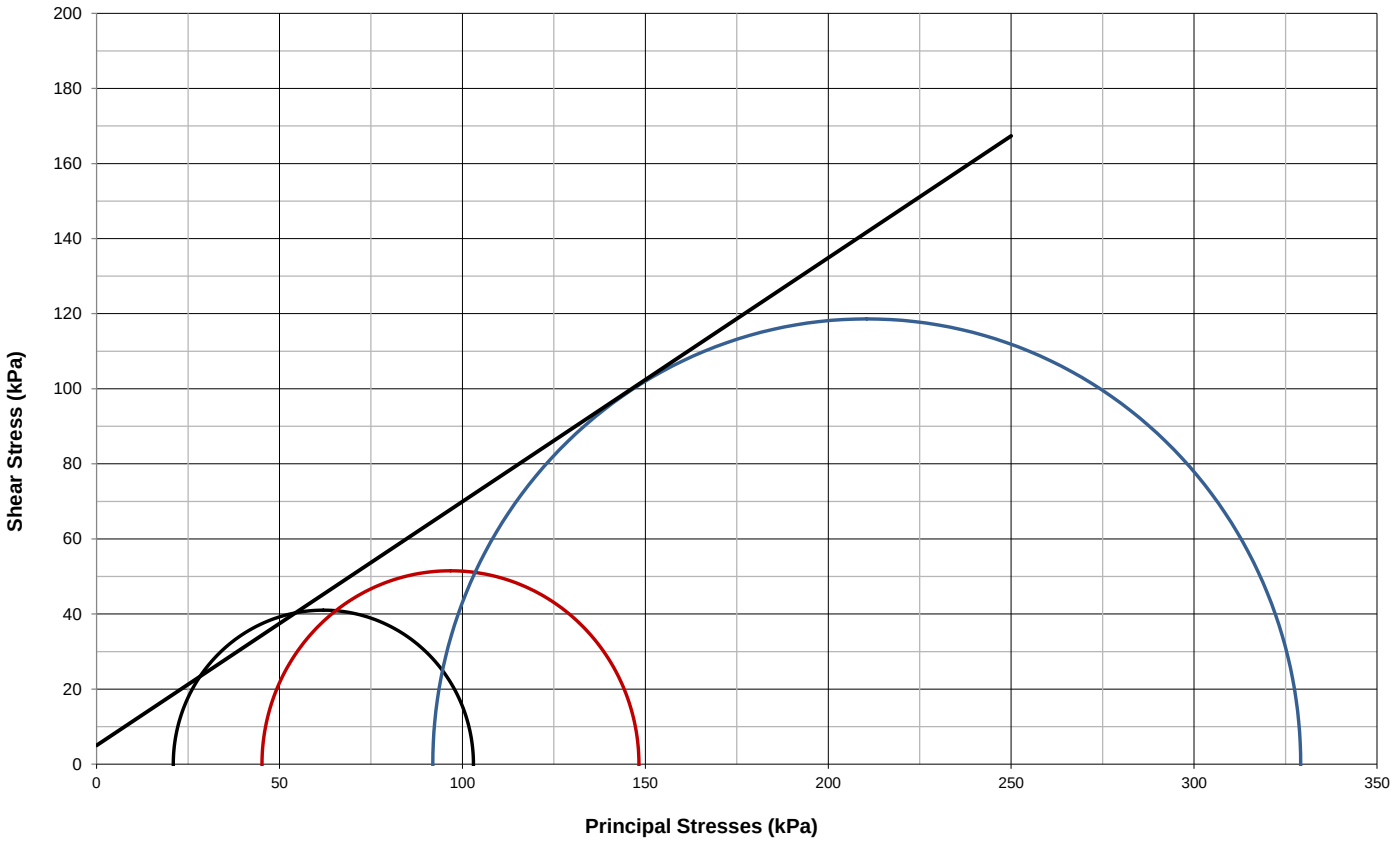
Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 15 **Depth (m):** 3.2-3.5 **Date:** 26/08/2021

Lab no: G21-0567 Sample Condition: Undisturbed

Shear Parameters of Effective Stresses		
Angle of Internal Friction	Deg.	**33**
Cohesion	kPa	**5**

Effective Shear Strength



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CONSOLIDATED UNDRAINED TRIAXIAL TEST

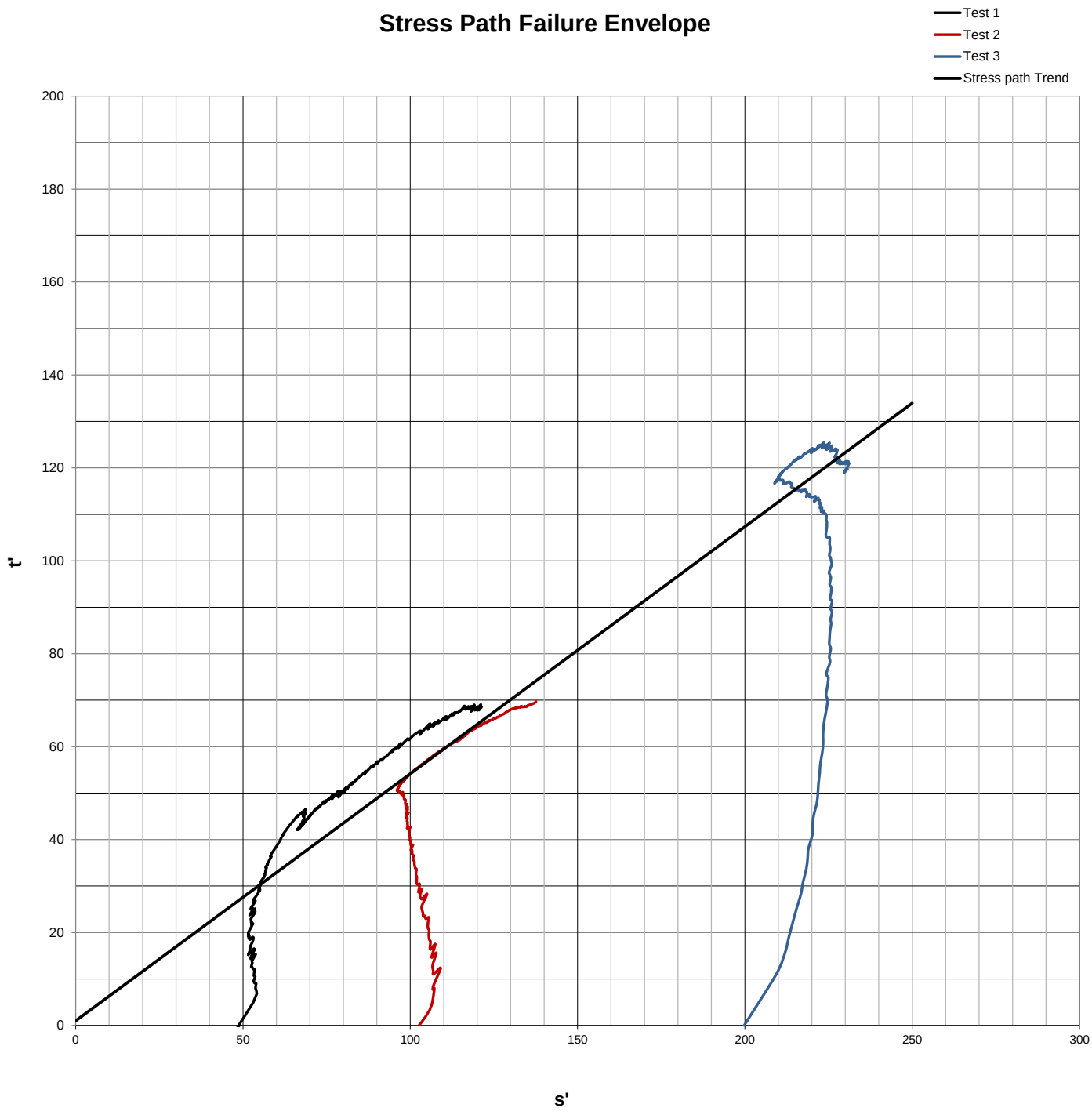
BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 15 **Depth (m):** 3.2-3.5 **Date:** 26/08/2021

Lab no: G21-0567 Sample Condition: Undisturbed

Shear Parameters at Failure		
Angle of Internal Friction	Deg.	**28**
Cohesion	kPa	**1**



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CONSOLIDATED UNDRAINED TRIAXIAL TEST

BS 1377 Part 8

Client: EPOCH RESOURCES **Project:** THARISA FW WRD 2 **Job no:** 39458

Sample no: TP 15 **Depth (m):** 3.2-3.5 **Date:** 26/08/2021

Lab no: G21-0567

Test 1

BEFOR TEST

AFTER TEST

Test 2

BEFOR TEST

AFTER TEST

Test 3

BEFOR TEST

AFTER TEST

SGS MATROLAB

Flexible Wall Permeability Test

BS 1377 Part 6

Client EPOCH RESOURCES **Project** THARISA FW WRD 2 **Job no** 39458

Sample no TP 01 **Depth (m)** 2.1-2.4 **Date** 29/09/2021

Lab no G21-0564

Initial Sample Parameters		
Sample Condition	-	Remoulded by hand
Proctor	kg / m^3	1845
OMC	%	6.7
Consolidation Pressure	kPa	100
Pressure Difference	kPa	10

Test Information			
Moisture Content	Before	%	6.8
	After	%	20.6
Dry Density		Kg/m³	1773
Initial Void Ratio		-	0.567
Relative Density (SG)		-	2.779 - Determined
Initial Degree of Saturation		%	33.1
Final B Parameter		-	0.98
Co-efficient of Permeability	Min.	m/s	2.40E-07
	Max.	m/s	1.45E-06
	Ave.	m/s	**6.92E-07**

SGS MATROLAB

Flexible Wall Permeability Test

BS 1377 Part 6

Client EPOCH RESOURCES **Project** THARISA FW WRD2 **Job no** 39458

Sample no TP 05 **Depth (m)** 1.0-1.3 **Date** 15/09/2021

Lab no G21-0565

Initial Sample Parameters		
Sample Condition	-	UNDISTURBED
Proctor	kg / m^3	N/A
OMC	%	N/A
Consolidation Pressure	kPa	100
Pressure Difference	kPa	10

Test Information			
Moisture Content	Before	%	34.5
	After	%	37.2
Dry Density		Kg/m³	1225
Initial Void Ratio		-	1.081
Relative Density (SG)		-	2.55 - Determined
Initial Degree of Saturation		%	81.3
Final B Parameter		-	0.96
Co-efficient of Permeability	Min.	m/s	1.39E-11
	Max.	m/s	7.19E-10
	Ave.	m/s	**3.09E-10**

SGS MATROLAB

Flexible Wall Permeability Test

BS 1377 Part 6

Client EPOCH RESOURCES **Project** THARISA FW WRD 2 **Job no** 39458

Sample no TP 14 **Depth (m)** 3.1-3.4 **Date** 15/10/2021

Lab no G21-0566

Initial Sample Parameters		
Sample Condition	-	UNDISTURBED
Proctor	kg / m^3	N/A
OMC	%	N/A
Consolidation Pressure	kPa	100
Pressure Difference	kPa	10

Test Information			
Moisture Content	Before	%	14.8
	After	%	16.9
Dry Density		Kg/m³	1841
Initial Void Ratio		-	0.440
Relative Density (SG)		-	2.651 - Determined
Initial Degree of Saturation		%	89.3
Final B Parameter		-	0.98
Co-efficient of Permeability	Min.	m/s	2.57E-10
	Max.	m/s	5.54E-10
	Ave.	m/s	**4.06E-10**

SGS MATROLAB

Flexible Wall Permeability Test

BS 1377 Part 6

Client EPOCH RESOURCES **Project** THARISA FW WRD 2 **Job no** 39458

Sample no TP 14 **Depth (m)** 3.1-3.4 **Date** 15/10/2021

Lab no G21-0566

Initial Sample Parameters		
Sample Condition	-	UNDISTURBED
Proctor	kg / m^3	N/A
OMC	%	N/A
Consolidation Pressure	kPa	100
Pressure Difference	kPa	20

Test Information			
Moisture Content	Before	%	14.8
	After	%	16.9
Dry Density		Kg/m³	1841
Initial Void Ratio		-	0.440
Relative Density (SG)		-	2.651 - Determined
Initial Degree of Saturation		%	89.3
Final B Parameter		-	0.98
Co-efficient of Permeability	Min.	m/s	7.06E-11
	Max.	m/s	6.97E-09
	Ave.	m/s	**1.60E-09**

SGS MATROLAB

Flexible Wall Permeability Test

BS 1377 Part 6

Client EPOCH RESOURCES **Project** THARISA FW WRD 2 **Job no** 39458

Sample no TP 14 **Depth (m)** 3.1-3.4 **Date** 15/10/2021

Lab no G21-0566

Initial Sample Parameters		
Sample Condition	-	UNDISTURBED
Proctor	kg / m^3	N/A
OMC	%	N/A
Consolidation Pressure	kPa	100
Pressure Difference	kPa	50

Test Information			
Moisture Content	Before	%	14.8
	After	%	16.9
Dry Density		Kg/m³	1841
Initial Void Ratio		-	0.440
Relative Density (SG)		-	2.651 - Determined
Initial Degree of Saturation		%	89.3
Final B Parameter		-	0.98
Co-efficient of Permeability	Min.	m/s	2.86E-11
	Max.	m/s	2.24E-09
	Ave.	m/s	**6.07E-10**

SGS MATROLAB

Flexible Wall Permeability Test

BS 1377 Part 6

Client EPOCH RESOURCES **Project** THARISA FW WRD 2 **Job no** 39458

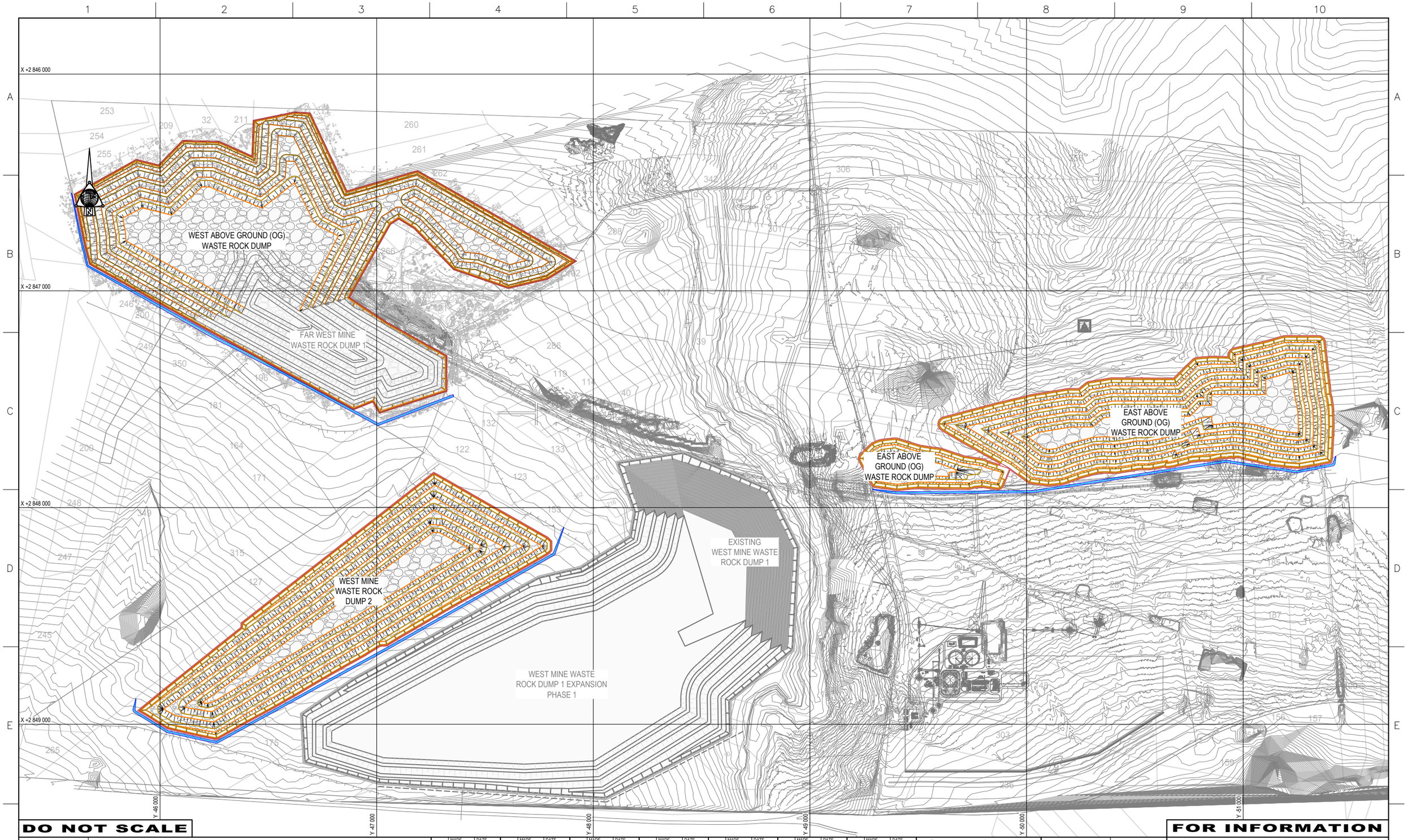
Sample no TP 15 **Depth (m)** 3.2-3.5 **Date** 21/09/2021

Lab no G21-0567

Initial Sample Parameters		
Sample Condition	-	UNDISTURBED
Proctor	kg / m^3	N/A
OMC	%	N/A
Consolidation Pressure	kPa	100
Pressure Difference	kPa	10

Test Information			
Moisture Content	Before	%	31.1
	After	%	39.1
Dry Density		Kg/m³	1231
Initial Void Ratio		-	1.162
Relative Density (SG)		-	2.661 - Determined
Initial Degree of Saturation		%	71.3
Final B Parameter		-	0.96
Co-efficient of Permeability	Min.	m/s	1.46E-08
	Max.	m/s	3.80E-08
	Ave.	m/s	**2.25E-08**

APPENDIX 2: DRAWINGS



DO NOT SCALE

FOR INFORMATION

DRAWING No.	DRAWING TITLE
144–016–951	FAR WEST WASTE ROCK DUMP 2 – GENERAL ARRANGEMENT
144–016–954	EAST PIT WASTE ROCK DUMP – GENERAL ARRANGEMENT
144–016–957	WEST MINE WASTE ROCK DUMP 2 – GENERAL ARRANGEMENT
REFERENCE DRAWINGS	

	MADE	DATE	APPD	DATE
3				
2				
1				
0				
C				
B				
A	M.H.	23.09.21		

ISSUED FOR INFORMATION

PROFESSIONAL REGISTRATION	
NAME: G.J. WIID	
PR.ENG.No. 940269	
DATE: 29/03/2022	
SIGNED: DocuSigned by: Greg Wiid C712C6A7A2DB48A...	DATE:
	SIGNED:

ISSUED FOR:
- MANUFACTURE ☐
- CONSTRUCTION ☐
- APPROVAL ☐
- COMMENT ☐
- PRICING ☐
- INFORMATION ☒

DRAWN	MUHAMMED
DATE	MARCH, 2022
CHECKED BY	A. STOFFBERG
DATE	MARCH, 2022
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	

CO-ORD SYSTEM: UTM, WGS 84, Lo27

SCALE	
A1	1:8000
A3	1:16000

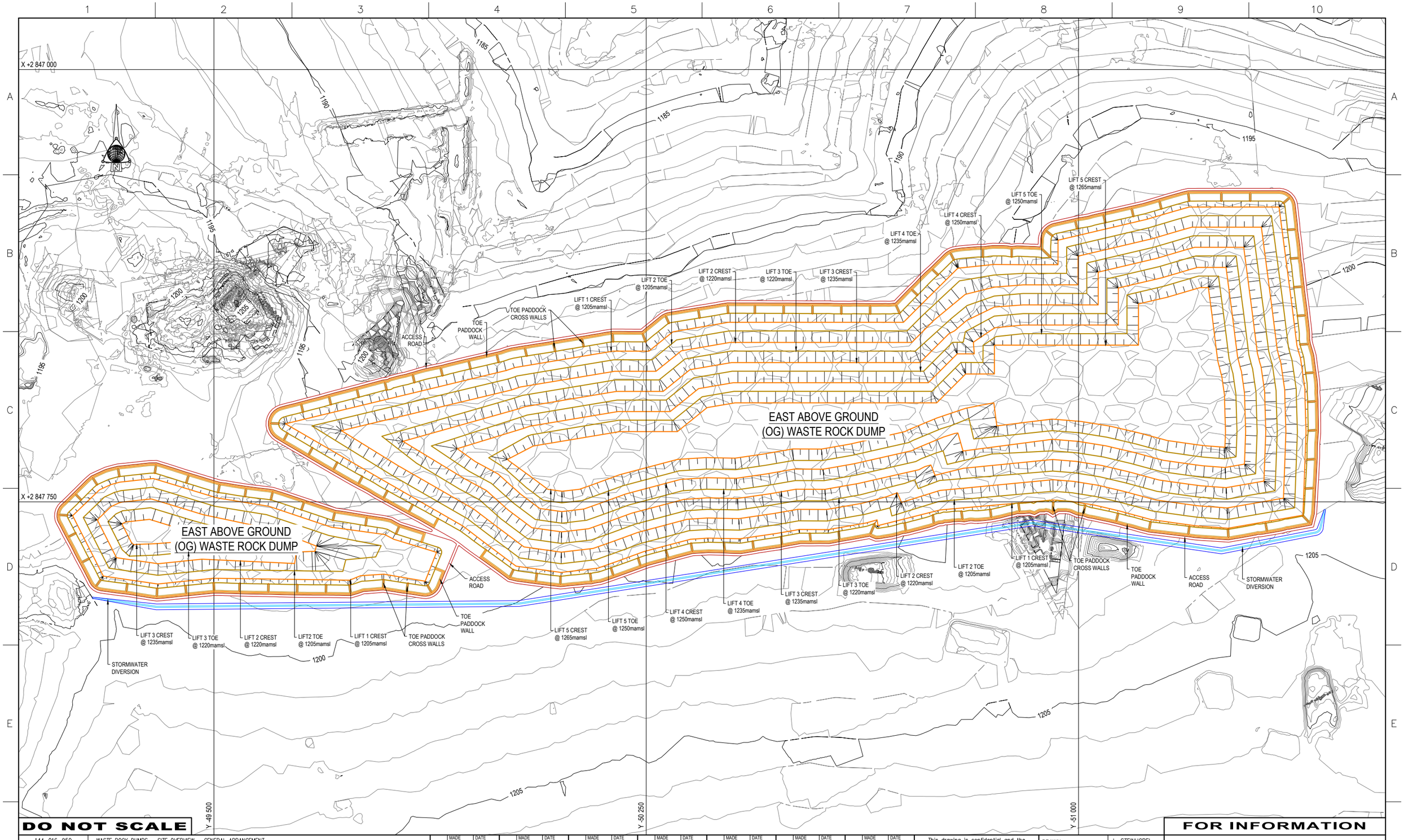
epoch resources
mine residue and environmental engineering consultants

TITLE
THARISA MINERALS
WASTE ROCK DUMPS
SITE OVERVIEW
GENERAL ARRANGEMENT

DRG No. 144-016-950

REV. A

A1



DO NOT SCALE

DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS	
144-016-950	WASTE ROCK DUMPS – SITE OVERVIEW – GENERAL ARRANGEMENT
144-016-955	EAST PIT WASTE ROCK DUMP – PHASE DEVELOPMENT – GENERAL ARRANGEMENT
144-016-956	EAST PIT WASTE ROCK DUMP – TYPICAL SECTIONS AND DETAILS

	MADE	DATE	APPD	DATE
3				
2				
1				
0				
C				
B				
A	L.S.	23.09.21		

ISSUED FOR INFORMATION

PROFESSIONAL REGISTRATION
NAME: G.J. WIID
PR.ENG.No. 940269
DATE: 29/03/2022
SIGNED: DocuSigned by: CT12C6A7A2D848A...

ISSUED FOR:
MANUFACTURE ☐
CONSTRUCTION ☐
APPROVAL ☐
COMMENT ☐
PRICING ☐
INFORMATION ☒

DATE:
SIGNED:

DRAWN	L. STEINHOBEL
DATE	MARCH, 2022
CHECKED BY	
DATE	
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	
CO-ORD SYSTEM	UTM WGS 84 Lo27
SCALE	A1 1:3000, A3 1:6000

FOR INFORMATION

epoch resources
mine residue and environmental engineering consultants

TITLE
THARISA MINERALS
EAST ABOVE GROUND (OG) WASTE ROCK DUMP
GENERAL ARRANGEMENT

DRG No. 144-016-954
REV. A

A1

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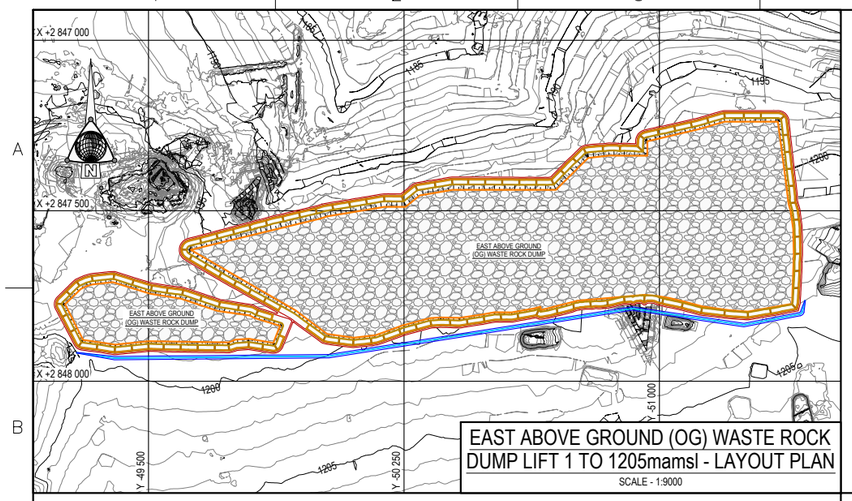
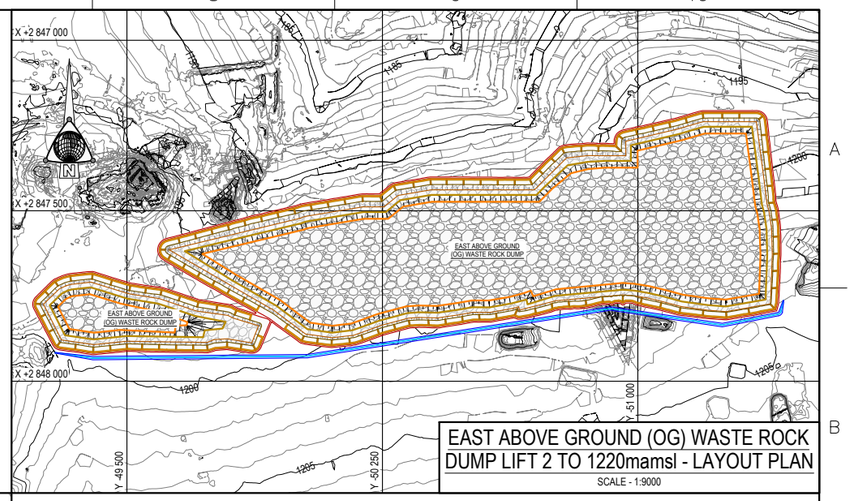


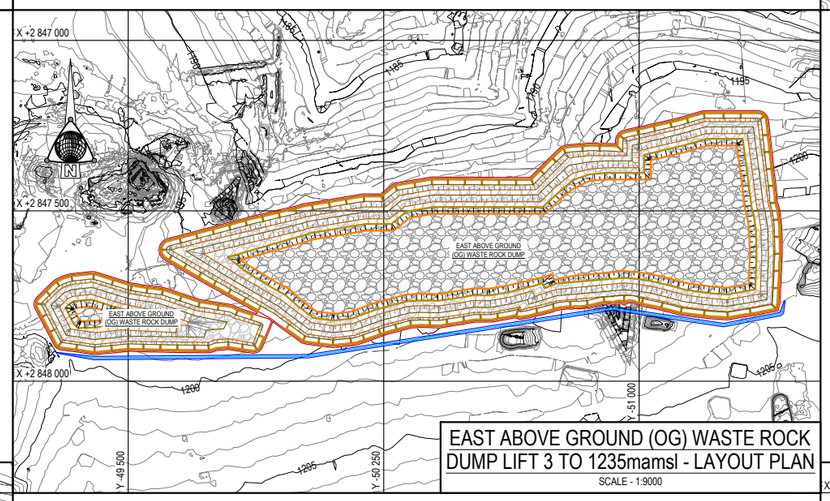
EAST ABOVE GROUND (OG) WASTE ROCK DUMP LIFT 1 TO 1205mamsl - LAYOUT PLAN

SCALE - 1:9000



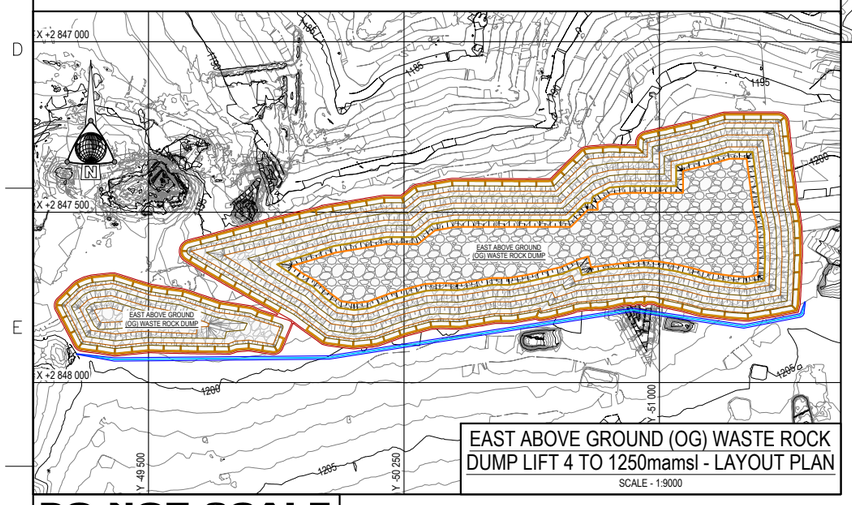
EAST ABOVE GROUND (OG) WASTE ROCK DUMP LIFT 2 TO 1220mamsl - LAYOUT PLAN

SCALE - 1:9000



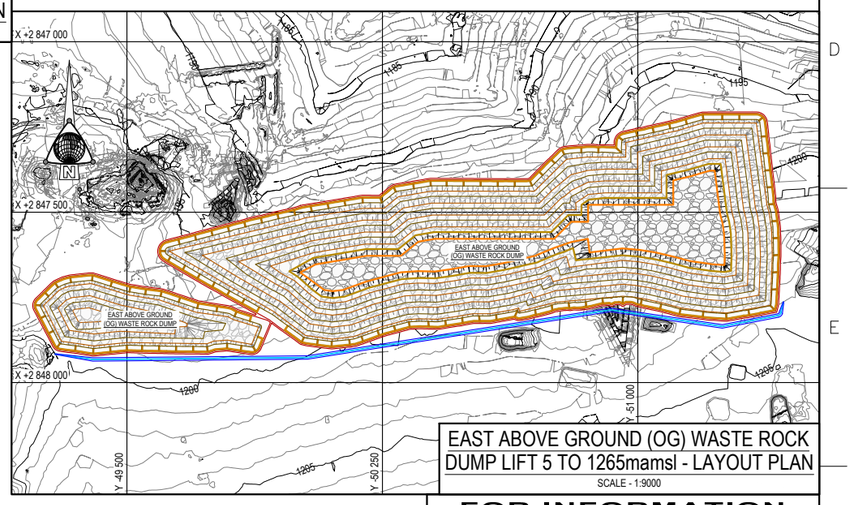
EAST ABOVE GROUND (OG) WASTE ROCK DUMP LIFT 3 TO 1235mamsl - LAYOUT PLAN

SCALE - 1:9000



EAST ABOVE GROUND (OG) WASTE ROCK DUMP LIFT 4 TO 1250mamsl - LAYOUT PLAN

SCALE - 1:9000



EAST ABOVE GROUND (OG) WASTE ROCK DUMP LIFT 5 TO 1265mamsl - LAYOUT PLAN

SCALE - 1:9000

DO NOT SCALE

FOR INFORMATION

144–016–950	WASTE ROCK DUMPS – SITE OVERVIEW – GENERAL ARRANGEMENT
144–016–954	EAST PIT WASTE ROCK DUMP – GENERAL ARRANGEMENT
144–016–956	EAST PIT WASTE ROCK DUMP – TYPICAL SECTIONS AND DETAILS

DRAWING No. | DRAWING TITLE

REFERENCE DRAWINGS

	MADE	DATE	APPD	DATE
3				
2				
1				
0				
C				
B				
A	L.S.	23.09.21		

ISSUED FOR INFORMATION

PROFESSIONAL REGISTRATION

NAME: G.J. WIID

PR.ENG.No. 940269

DATE: 29/03/2022

SIGNED: DocuSigned by: Greg Wiid C712C6A7A2DB48A...

ISSUED FOR:
- MANUFACTURE ☐
- CONSTRUCTION ☐
- APPROVAL ☐
- COMMENT ☐
- PRICING ☐
- INFORMATION ☒

DATE:

SIGNED:

DRAWN	L. STEINHOBEL
DATE	MARCH, 2022
CHECKED BY	
DATE	
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	
CO-ORD SYSTEM	UTM WGS 84 Lo27
SCALE A1	1:9000
SCALE A3	1:18000

epoch resources — mine residue and environmental engineering consultants

TITLE

THARISA MINERALS
EAST ABOVE GROUND (OG) WASTE ROCK DUMP
PHASE DEVELOPMENT
GENERAL ARRANGEMENT

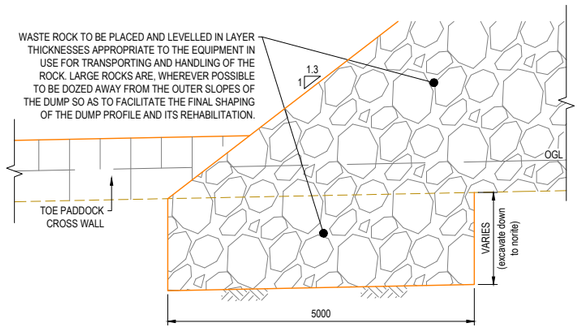
DRG No. 144-016-955

REV. A

A1

LEGEND:

RIP AND RE-COMPACT IN-SITU MATERIAL 300mm DEEP TO AT LEAST 98% OF STANDARD PROCTOR DENSITY, AND WITHIN -X1 AND +X2% OF O.M.C.

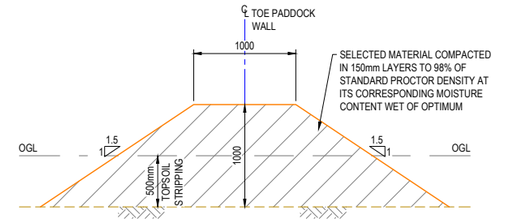


TYPICAL CLAY KEY EXCAVATION DETAIL

SCALE - 1:50

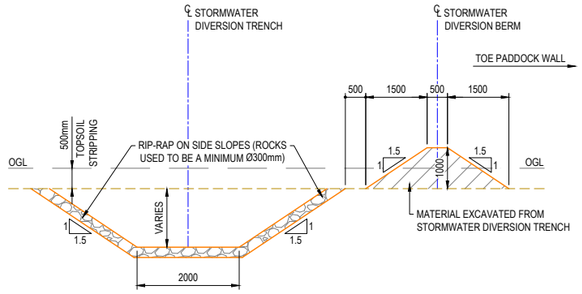
TYPICAL SECTION THROUGH PHASED DEVELOPMENT OF EAST ABOVE GROUND (OG) WASTE ROCK DUMP

SCALE - 1:350



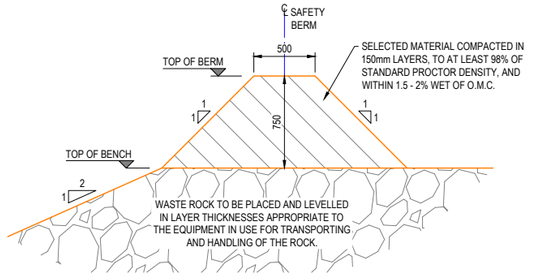
TYPICAL TOE PADDOCK WALL DETAIL

SCALE 1:30



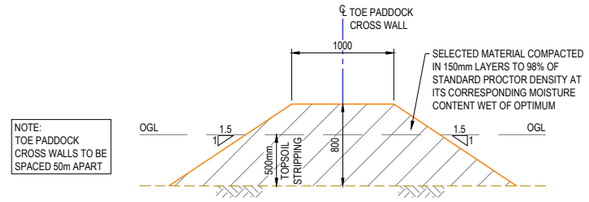
TYPICAL SECTION THROUGH STORMWATER DIVERSION

SCALE - 1:75



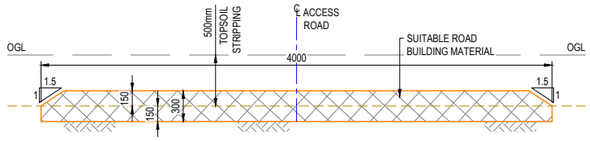
TYPICAL SECTION THROUGH WRD SAFETY BERM

SCALE - 1:25



TYPICAL TOE PADDOCK CROSS-WALL DETAIL

SCALE 1:30



TYPICAL ACCESS ROAD DETAIL

SCALE - 1:30

DO NOT SCALE

FOR INFORMATION

144-016-954	EAST PIT WASTE ROCK DUMP – GENERAL ARRANGEMENT
DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS	

	MADE	DATE	APPD	DATE
3				
2				
1				
0				
C				
B				
A	M.H.	23.09.21		

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NAME: G.J. WIID	
PR.ENG.No. 940269	
DATE: 29/03/2022	
SIGNED:	DocuSigned by: Greg Wiid C712C6A7A2D848A...

ISSUED FOR:
MANUFACTURE ☐
CONSTRUCTION ☐
APPROVAL ☐
COMMENT ☐
PRICING ☐
INFORMATION ☒

DATE:
SIGNED:

DRAWN	MUHAMMED
DATE	MARCH, 2022
CHECKED BY	S. BARKHUIZEN
DATE	MARCH, 2022
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	
CO-ORD SYSTEM	UTM WGS 84 Lo27

SCALE	
A1	AS SHOWN
A3	AS SHOWN x 2

epoch resources
mine residue and environmental engineering consultants

TITLE

THARISA MINERALS
EAST ABOVE GROUND (OG) WASTE ROCK DUMP
TYPICAL SECTIONS AND DETAILS

DRG No. 144-016-956

REV. A

A1

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